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COMPENDIUM OF CRATER DATA

TECHNICAL REPORT NO. 2-547

Report 1

May 1960

U. S. Army Engineer Waterways Experiment Station
CORPS OF ENGINEERS
Vicksburg, Mississippi

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ARMY-MRC VICKSBURG, MISS.

PREFACE

This report is the first of two reports on the general subject, cratering from high explosive charges; it compiles in narrative and tabular form all available HE cratering data from test series in various media. The second report will analyze empirically the results reported herein. The study was conducted for the Office, Chief of Engineers, Department of the Army, as a part of Research and Development Subproject 8-12-95-420, "Nuclear Weapons Effects on Structures, Terrain, and Waterways" (Unclassified). It was accomplished during the period October 1957 through June 1959 by personnel of the Special Investigations Section, Hydraulics Division, U. S. Army Engineer Waterways Experiment Station, under the general supervision of Messrs. E. P. Fortson, Jr., and F. R. Brown. This report was prepared by SP-5 R. A. Sager, SP-4 C. W. Denzel, and Mr. W. B. Tiffany under the direct supervision of Messrs. G. L. Arbuthnot, Jr., and J. N. Strange.

The comments and suggestions of Cdr. W. J. Christensen, LCdr. B. S. Merrill, and Maj. E. H. Kleist as to the style and arrangement of the material are gratefully acknowledged.

Col. Edmund H. Lang, CE, was Director of the Waterways Experiment Station during the preparation of this report. Mr. J. B. Tiffany was Technical Director.

CONTENTS

NOTATIONS

d_a Apparent crater depth, ft

d_t True crater depth, ft

D_h Horizontal diameter of camouflet, ft

D_v Vertical diameter of camouflet, ft

h_a Average crater lip height, ft

r_a Average apparent crater radius, ft

r_r Average radius of rupture of camouflet, ft

r_t Average true crater radius, ft

V_a Volume of apparent crater, cu ft

V_c Volume of camouflet, cu ft

V_t Volume of true crater, cu ft

W TNT equivalent charge weight, lb

Z Depth of burial of charge, ft

α_a Average apparent crater angle, degrees (see fig. 2)

α_t Average true crater angle, degrees (see fig. 2)

λ_c Reduced charge position, $Z/W^{1/3}$, ft/lb$^{1/3}$

SUMMARY

Any effort to perform an all-inclusive analysis of HE cratering experiments has, in the past, met with serious difficulties because of the intensive and laborious literature search necessary for the accumulation of pertinent data. This report was prepared in order to summarize all HE cratering data in a single report and thus facilitate future reference and correlation attempts. A second report will analyze the results presented herein.

The data compiled herein are presented in narrative and tabular form and have been grouped according to data obtained from cratering in soils (which includes clays, loess, silt, sand, etc.), frozen ground, rock, ice, and snow. Craters resulting from underwater shots are not considered in this report.

CRATERING FROM HIGH EXPLOSIVE CHARGES

COMPENDIUM OF CRATER DATA

PART I: INTRODUCTION

1. Any future application of large HE and nuclear explosions will doubtlessly involve near-surface or below-surface detonations which will produce craters of more or less conventional shape. The military applications of cratering are more or less obvious--e.g., to damage or destroy underground installations, to create barriers in various situations, etc.; however, the cratering process is now being studied in some detail for prospective civil applications to accomplish a variety of tasks. Whether the application be civil or military, it is certainly desirable to be able to predict with the greatest possible accuracy every phase of the cratering process, but particularly to be able to predict the size and shape of the crater formed.

2. In the past, any effort to analyze and correlate cratering data from HE explosions has met with considerable difficulty. Most of these data are presented in countless reports where they are treated as primary information or simply reported as incidental phenomena. By compiling and properly tabulating all of the HE cratering data under one cover, a substantial contribution will be made to future efforts at specific or comparative analyses.

3. Therefore, all pertinent HE cratering data, located during an exhaustive literature search, have been included in tables 1-6 of the main body of this report (covering crater and camouflet measurements in soil, and crater measurements in frozen ground, rock, ice, and snow) and table A1 of the appendix (giving additional crater measurements in soil). Every effort was made during the search to obtain every report published which contained cratering data; however, in an undertaking of this scope, it is recognized that some data were probably overlooked. Persons having access to cratering data not included in this report are requested to transmit these data in tabular form (similar to the format of tables 1-6) along with as detailed a description of the media as possible to: Director, U. S. Army

Engineer Waterways Experiment Station, CE, P. O. Box 631, Vicksburg, Mississippi, ATTN: Chief, Special Investigations Section. Additional data so received will be published as appendices to this report. A second report on this same general subject, namely, cratering from high explosive charges, will analyze empirically the results presented herein.

4. Cratering data from underwater shots have been purposely omitted.

PART II: THE LITERATURE SEARCH AND DATA TABULATION PROCEDURES

Literature

5. As stated in Part I, the Waterways Experiment Station (WES) has conducted, over a period of several years, an exhaustive literature search of all available reports, papers, and personal notes (some of which were, at the time received, unpublished) that contained cratering data. From this intensive survey, a bibliography has been prepared and is presented at the end of the narrative portion of this report.

6. The cratering data tabulated herein were extracted almost entirely from the formal reports listed in the bibliography; a small amount was obtained from shot records and personal notes describing various test results wherein cratering was a secondary measurement. A few of the reports listed in the bibliography did not contribute per se to the wealth of data tabulated; however, these particular reports were included since they supplement reports from which cratering data were extracted. For example, references 9-12 and 16 supplement the data from the Engineering Research Associates' (ERA) Underground Explosion test program, references 13-15. Similarly, three reports (33, 36, and 54) supplement the data from the Project Mole series, reference 32; one report (45) supplements the data obtained from the Panama Canal series, references 46-50; five reports (24, 25, 28, 30, and 31) include information that may assist in analyzing these data; four reports (3, 18, 29, and 34) present limited compendiums of cratering data; and two reports (26 and 27) include descriptions of the soil at several test sites from which cratering data were obtained.

Grouping of Data

7. Various crater measurements were obtained from more than 1800 shots. Arrangement of these data into similar or kindred groups was accomplished in order to assist users in attempts to analyze the data. Grouping of the data was accomplished by considering the following test parameters in the order named: type of media cratered, shape of charge, position of charge, and weight of charge.

Media grouping

8. Based upon the grouping procedure just described, the following tabulation shows the media groupings under which the data are tabulated:

Table	Media
1	Soil
2	Soil (camouflet measurements)
3	Frozen ground
4	Rock
5	Ice
6	Snow

Soil-type grouping

9. Crater and camouflet measurements in soils (tables 1 and 2, respectively) were subdivided into various soil types and further grouped to describe qualitatively the condition of the soil as to moisture content. The first of these groupings (soil types) was easily determined using accepted soil-classification procedures. The grouping according to moisture content was somewhat arbitrary. Where moisture-content data were available, the following criteria were established for classifying a given soil as wet, moist, or dry:

Type Soil	Moisture Content, %
Dry clay	0-12
Moist clay or loess	13-22
Wet clay or silt	>22
Dry-to-moist sand	0-3
Wet sand	>7

It is recognized that the assignment of numerical limits to the various conditions of wet, moist, and dry is highly dependent on grain size, organic content, etc.; however, the criteria given are believed to be acceptable as a "rule of thumb" for grouping the data into similar conditions of moisture content.

10. When moisture-content data were not available, the soil was placed in a given category based upon its general description contained in the particular report. Soils that could not be classed as wet, moist, or dry were grouped together and labeled "indefinite."

Grouping by charge shape

11. Among the shots included in the tabulations, many of the charges detonated were not spherically shaped. Because of this, it was necessary

to define arbitrarily when a given charge departed sufficiently from resembling a point source of energy to be considered a shaped charge. Perhaps the best way to define which charges are considered shaped and which unshaped is to describe the unshaped charge. To begin with, an unshaped charge exhibits blast effects as though they originated from a point source of energy. Accordingly, spherically shaped charges were considered unshaped. Also, charges that were cubically shaped or that were built up of smaller charges into a cube were considered to be unshaped. Likewise, cylindrical or rectangular charges (with square base) were not considered shaped charges provided the height-to-diameter (width of base) ratio was less than 1.5. All charges not falling within these restrictions were considered to be shaped or to propagate the explosive energy asymmetrically to an objectionable degree.

12. Grouping by charge shape was required only in table 1 as the data contained in tables 2-6 were obtained from shots involving unshaped charges exclusively. Cratering data derived from detonations of shaped charges are presented in sheets 19-24 of table 1.

Charge-position grouping

13. Order. Each shot from a given series of shots in a given medium was listed in order using the charge position as the governing criterion. Those placed highest aboveground were listed first, and those positioned deepest underground were listed last. This grouping was based on the reduced charge position, λ_c. In keeping with conventional practice, TNT was used as the base explosive; all other explosive types were converted to equivalent weights of TNT by using conversion factors, when such were available, as described in the following paragraphs.

14. Conversion of other explosives to TNT weights. The only available conversion factors for cratering were those developed by Lampson.[21]* In a series of experimental tests, equal weights of TNT and some other explosive were detonated at identical charge positions. The craters were measured and the crater radii compared. As defined by Lampson,

$$\frac{r_x}{r_{TNT}} = \frac{E_x}{E_{TNT}} \left(\frac{W_x}{W_{TNT}} \right)^{1/3} \quad (1)$$

* Raised numbers refer to similarly numbered items in the Bibliography at end of text.

where

r_x = crater radius using explosive x, ft
r_{TNT} = crater radius using TNT, ft
E_x = explosive factor for explosive x, dimensionless
E_{TNT} = explosive factor for TNT, dimensionless
W_x = weight of explosive x, lb
W_{TNT} = weight of TNT, lb

Since TNT is used as the accepted base explosive, then $E_{TNT} = 1$ and

$$E_x = \frac{r_x}{r_{TNT}}\left(\frac{W_{TNT}}{W_x}\right)^{1/3}$$

To convert a given amount of explosive x to an equivalent weight of TNT, a specific weight of TNT must be found that will make

$$r_{TNT} = r_x \text{ , or } \frac{r_x}{r_{TNT}} = 1$$

Therefore, from equation 1,

$$1 = \frac{E_x}{E_{TNT}}\left(\frac{W_x}{W_{TNT}}\right)^{1/3}$$

Again, $E_{TNT} = 1$ and

$$E_x = \left(\frac{W_{TNT}}{W_x}\right)^{1/3}$$

or

$$W_{TNT} = E_x^3 W_x$$

Letting $E_x^3 = k$, the conversion equation becomes

$$W_{TNT} = k\, W_x \tag{2}$$

Note that k in equation 2 is equivalent to Lampson's E_x^3.

15. The following conversion factors were derived by Lampson in reference 21.

Explosive	Conversion Factor, k
Amatol	0.94
Composition B	1.06
Dynamite (40% extra)	0.68
HBX-2	1.52
Minol	1.48
Pentolite	1.23
TNT	1.00
Tritonal	1.37

It should be noted that the above-listed factors are based on crater radius only and may be inappropriate for crater depth; however, since no other conversion system was available, the foregoing was used throughout this report to convert these types of explosives to equivalent weights of TNT. Conversion factors for these same explosives, based on the release of equal amounts of energy, are given in a paper by Cdr. Christensen.[3]

16. By means of the above-listed factors, equivalent weights of TNT were computed and used in determining the value of λ_c appropriate for the specified shot geometry. For those explosive types for which a conversion factor was not available, a value of λ_c was determined by using the actual weight of the explosive in conjunction with the particular depth of burial of charge. Although this procedure is only approximate, it does provide a means of placing the shot at or near its proper location within the respective tabulations.

Charge-weight grouping

17. When several shots were detonated at a common scaled depth of burial (λ_c remains constant), the shots were tabulated in the order of ascending weight of charge.

Table Nomenclature

18. The column headings for the six tables are generally the same, and the following descriptions are intended to clarify these headings.

Item Number provides a consecutive count of the total number of listings.

Source reveals the source of the data listed; the number refers to the corresponding number in the Bibliography.

Explosive Data describe the charge used as to type and weight of

explosive and, when possible, define the weight of TNT that is the equivalent in cratering potential to the particular explosive used.

Charge Position describes the actual position of the charge with respect to the ground-air interface and the reduced position of the charge based on TNT equivalent or nonequivalent weights as discussed in paragraphs 13-16.

Crater Dimensions:

Apparent. Columns under this heading list the apparent crater depth, radius, height of lip, angle of intersection, and volume.

True. The true crater depth, radius, angle of intersection, and volume are listed under this general heading.

Camouflet. Subheadings under this general heading define the vertical and horizontal diameters of the camouflet, the radius of rupture, and the camouflet volume.

PART III: CRATER DIMENSIONS

Methods of Measuring the Various Crater Dimensions

19. Various methods were used to determine the crater dimensions tabulated herein, particularly in sounding the true crater. The following paragraphs discuss these methods.

Routine survey method

20. This method adapts the simple level-surveying techniques to determine the profile of the apparent crater. This simply involves the determining of the change in elevation that occurs over an established crater diameter. Variations of this rudimentary technique are also used in determining the true crater limits.

Probe method

21. This is a method of establishing the limits of the true crater and is based on detecting a marked change in resistance to penetration by a probe. The probe is pushed through the fallback (see fig. 1) until the resistance to continued penetration increases sharply. This increase supposedly occurs at the boundary of the true crater which is defined simply as the crater that existed prior to any fallback. Measurements obtained using this method exhibit considerable scatter which is primarily due to the fact that the probe can penetrate into a fissure that is in reality a part of the complete rupture zone, thus distorting considerably the penetration that should have been observed. Because of the inaccuracies inherent in this method, its use has been abandoned.

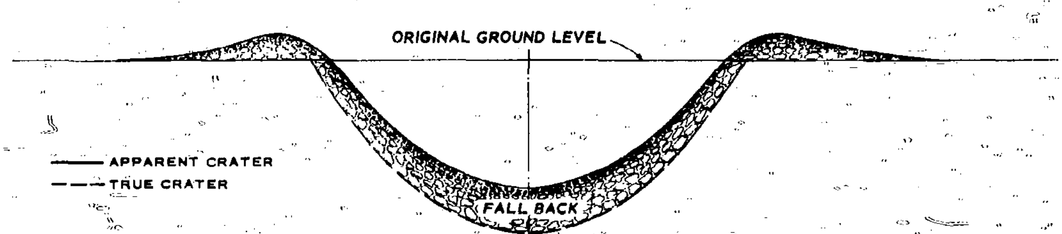

Fig. 1. Schematic crater section

Colored-column method

22. Along a line passing through ground zero, holes 2 to 4 in. in

diameter are drilled to depths roughly 25 per cent greater than the expected depth of the crater at any given range from surface zero. The holes are backfilled with a mixture of relatively fine sand, lime, and cement coloring in proportions that will provide density and strength properties very similar to the natural media. Immediately after the shot, a trench is excavated parallel to the line of holes but offset therefrom about 3 to 6 in. This 3- to 6-in. excess is then shaved away until the center of each colored column is exposed. The columns are then surveyed using the routine survey method described in paragraph 20. This colored-column method is very accurate for determining the limits of the true crater.

Hand excavation

23. In this method all loose material (fallback) is removed by hand and the "clean" crater is then surveyed. This method is appropriate for craters up to about 25 ft in diameter. Larger craters can normally be surveyed more easily using the colored-column method. The hand excavation method is just as accurate as the colored-column method, and is preferable in many instances, particularly for small craters.

Primary and Derived Crater Dimensions

Primary dimensions

24. Primary crater dimensions are those that are measured directly. Among these are: radius, depth, lip height, camouflet diameter, and perhaps others that some agencies may have obtained. Definition of the more widely used crater dimensions are shown schematically in figs. 2 and 3.

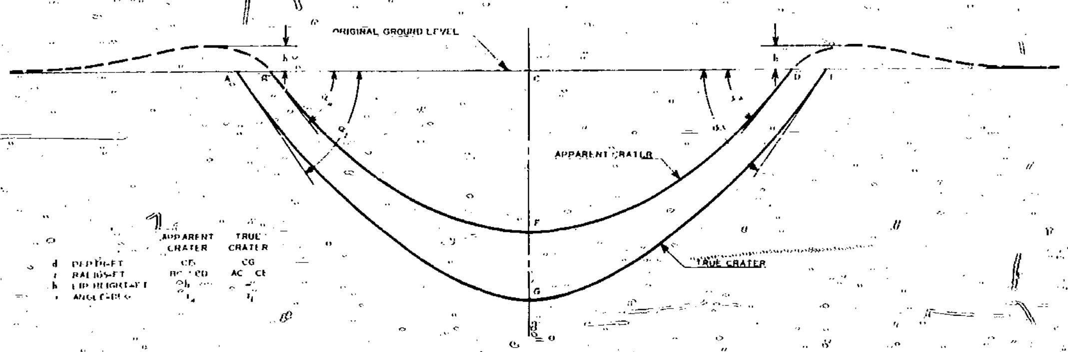

Fig. 2. Sketch defining crater nomenclature

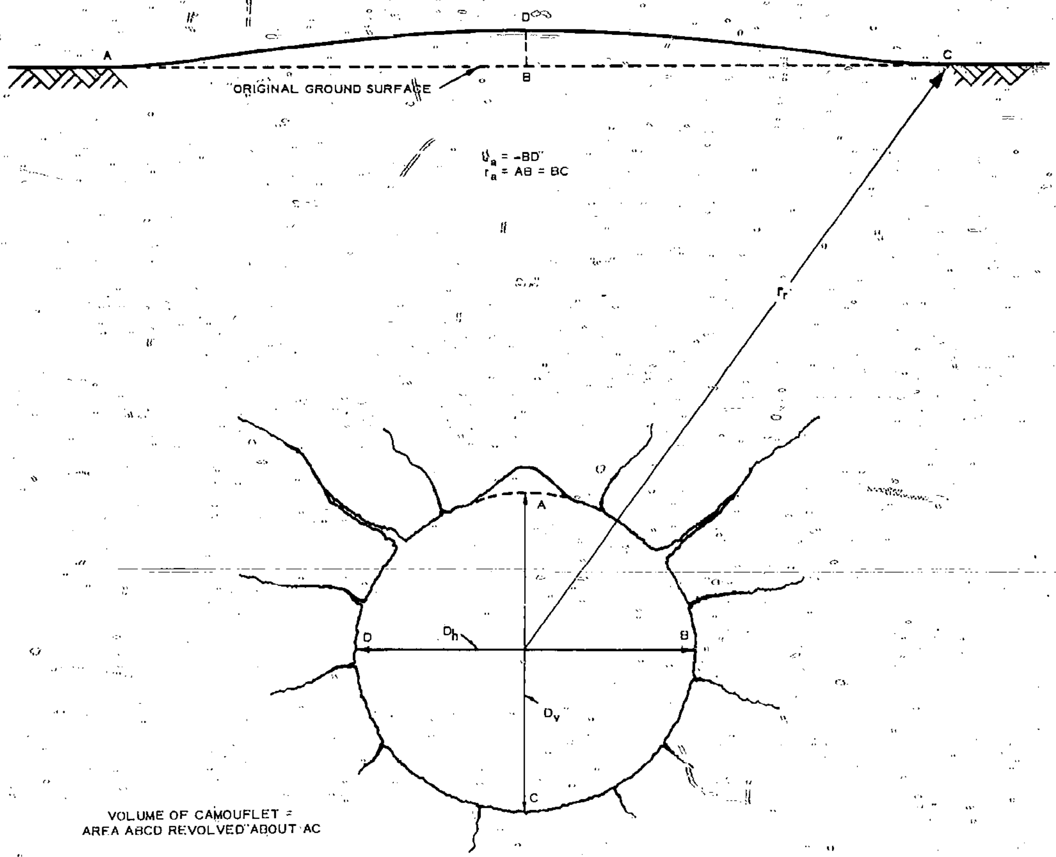

Fig. 3. Schematic diagram of typical camouflet and associated ground rise

25. The cratering data reported in reference 35 describe the crater radius as being the distance from ground zero to the maximum height of the crater lip. After a cursory study of crater shapes at various scaled depths of burial, it was concluded that these measurements could be made consistent with the definition shown in fig. 2 by multiplying the recorded radius by 0.8. Therefore, all values of crater radius extracted from reference 35 were reduced in this manner.

26. Some of the cratering data listed in reference 41 were influenced by an underlying rigid interface when the depth of overburden was less than a certain amount. For this reason, cratering data obtained from those shots influenced by the proximity of the interface were not included in the tabulations.

Derived dimensions

27. Derived crater dimensions are those that are computed. Among these are: area, volume, and sometimes the crater angle (see fig. 2). The crater volume was obtained by various agencies in several ways. Usually, however, it was computed by revolving the vertical, cross-sectional area of the crater through 180 degrees. In some instances, the average half-crater profile was used and revolved through 360 degrees. In isolated cases, the crater volume was determined by filling the void with some substance, noting the quantity used. Many of the references from which data were extracted did not describe the method used in computing the crater volume.

28. The crater angle (fig. 2) was determined from the average crater profile when it was provided. When profiles were not available, the depth, radius, and lip height were plotted on regular graph paper and an assumed profile of conventional shape was drawn through these plotted points. The appropriate crater angle was then measured from the profile as drawn.

PART IV: PROPERTIES OF THE VARIOUS MEDIA CRATERED

29. Since the size of a crater is also a function of the physical properties of the surrounding media, a general summary of these properties is presented for each of the test sites for which information on the media was available. Several of the test series reported soil properties for certain or all of the individual shots; however, the summary that follows is based on averages of the data provided.

Wet Clay

Dugway Proving Ground, Utah (table 1, source 15)

30. The test site is located about 30 miles west of the proving ground proper.

> "The material at the wet-clay site consisted of flat-lying, undisturbed layers of clay, the thickness of these layers ranging from 0.125 to 2 ft. Physically, the clay was quite homogeneous, the apparent layering being marked primarily by color variations. The deepest depth of clay recorded in a test drill hole was 62 ft. Below this depth, interbedded clays and sands probably occurred.
>
> "Approximately vertical joints were quite numerous at the wet-clay site. In general, they were not so wide as those in the dry clay, but some were open enough to permit the flow of water. Most of the joints struck north-south, but some occurred which struck east-west.
>
> "Seismic surveys, made by the Corps of Engineers, indicated that the seismic velocity was 2800 ft per second down to a depth of 3.5 ft; below this depth, the seismic velocity was 5600 ft per second. The 3.5-ft level probably corresponded to the water table."[15]

A summary of the Dugway test site soil data is presented in table 7.

Camp Cooke, California (table 1, source 32)

31. Test shots 311, 312, and 313 of the Project Mole test series were detonated at this site which is located near the mouth of the Santa Ynez River where the ground surface was approximately 5.5 ft above the water table. The surface was hard silty clay underlain by moist sandy clay

to a depth of at least 22 ft. Table 7 summarizes the soil data for this site.

Clear Lake, Texas
(table 1, source 20)

32. The test program conducted at Clear Lake was accomplished as a part of the Underground Explosion test series. These detonations took place in Gulf Coast clay, which is more specifically typed as a sedimentary clay. Apparently the soil exploration for this site was limited to a seismic survey, which revealed a velocity of 1020 fps to a depth of 7.5 ft and a velocity of 5610 fps below this depth. This sudden increase in the seismic velocity seems to define the upper limits of the water table which fluctuate during different seasons of the year.

Panama Canal
(table 1, source 49)

33. All test shots detonated in marine muck during the Panama Canal test program were made in an area between the original canal and the south Miraflores approach channel to the Third Locks of the Panama Canal.

> "The muck deposits are soft, very moist silts, clays, and organic deposits, which may be subdivided into four facies which intergrade laterally. These facies comprise gray to blue-gray silty clay; an organic black silt containing shells; black semi-decayed vegetable substances intermixed with silts; and light-gray or yellow-gray, weak plastic clay. This material was formed by deposition in swamps during Pleistocene time.
>
> "The area used for testing is partially covered by 3 to 5 feet of old hydraulic fill of which the top one-foot is a crust of medium-hard, medium-plastic, cohesive, brown, loamy clay. This crust is softened by water that covers the area at high tide. Directly beneath the brown clay is a very soft, very highly plastic, gray clay that resembles soft soap or grease. This layer varies in thickness from 3 to 12 feet. Most of the shallow and medium depth charges were embedded in this soft mucky clay. Below this stratum is a layer of silty sand from 1 to 3 feet deep which is followed by mucky clay and silt which reaches a depth of 20 to 30 feet. The top of weathered rock varies from a depth of 26 to 36 feet."[49]

Moist Clay

WES clay pad (tables 1 and 2, sources 39, 42, 43)

34. Cratering tests in moist clay were conducted at the WES Big Black test site located approximately 10 miles southeast of Vicksburg, Mississippi. The shots were detonated in a 200- by 100- by 8-ft-deep built-up clay pad (see reference 42 for details of construction of pad). A qualitative description of the soil is presented in table 7.

Vicksburg clay (table 1, source 44)

35. All test shots in moist clay for the WES energy-partitioning test program were detonated near the WES Big Black test site in a natural clay area. Average results of Atterberg limits tests on the natural clay were as follows: the plasticity index varied with depth from 30 at 2 ft to 13 at 5 ft to 6 at 23 ft, and averaged 13. Additional data are given in table 7.

Panama Canal residual clay (table 1, source 50)

36. All test shots fired in residual clay during the Panama Canal test series were located in an area of the Panama Canal known as White's Island. The area is an undisturbed clay barrier (located in the Third Locks alignment) that had been cut down to the present elevation and maintained as a dam between Miraflores Lake and the Third Locks excavation channel. The material consists of a compact, slightly plastic, medium cohesive, red and gray clay that is very uniform in physical characteristics (see table 7).

London clay (table 1, source 1)

37. No detailed information on the soil was given for the tests reported as conducted in London clay. However, it was assumed that the clay in this region would be moist to wet.

Dry Clay

Dugway Proving Ground
(table 1, sources 15, 32)

38. Test shots 301 through 320 of the ERA Underground Explosion test program and test shots 101 through 111 of the Project Mole test program were conducted at Dugway Proving Ground, Dugway, Utah.

> "The dry clay site was located at White Sage Flat, about 12.7 miles by road from the Dugway Proving Ground base camp. The site was investigated by the Corps of Engineers and its characteristics reported in detail...Great depths of lake sediments (fine unconsolidated material) were deposited there. Very thin sand lenses occurred and, below a depth of 20 feet, sand beds from one foot to ten feet thick were found. A white marl layer, whose thickness varied from hole to hole, was present. Many of the thin beds of the clays were discontinuous.
>
> "The most important structural features of the dry clay site were two sets of vertical joints, one striking north-south and the other east-west. The north-south joints were more prominent, some of them being from one to two inches wide and filled with fairly loose clay. It was felt that the presence of these joints had a significant effect on the results obtained at the dry clay site.
>
> "Fourteen seismic lines were shot at the dry clay site with velocities ranging from 1000 feet per second at a depth of 3.7 feet to 6150 feet per second at a depth of 93 feet. A velocity of 5400 feet per second was observed at the greatest depth measured, 138 feet.
>
> "Ground water at the site was considered negligible, and it was believed that the water table lay at a depth of 300 feet or more. No water table was encountered in the exploratory drill holes, one of which extended to a depth of 163 feet. A zone of capillary saturation was reported in two of the drill holes at a depth of 136 feet."[15]

39. For the Project Mole test program the moisture content of the soil was estimated to be greater than it had been during the Underground Explosion test program. A summary of the soil data is presented in table 7.

Aberdeen Proving
Ground (table 1, source 17)

40. These tests were conducted in a very hard, dry clay, the density of which averaged about 90 lb per cu ft.

Naval Ordnance Laboratory (table 1, source 35)

41. All cratering shots during this test program were detonated in a heavy, rock-free clay. The location of the test site was not reported. Because of considerable weather variation, the moisture content of the clay varied over a wide range of values. Specific values of moisture content were not given.

Wet Sand

Aberdeen Proving Ground (table 1, source 6)

42. Test shots 1A16 through 5A42 of the Ballistics Research Laboratory (BRL) spherical charge test program were detonated at Sandy Point Beach, Aberdeen Proving Ground, Maryland. Apparently no detailed soil explorations were made at this site except for determination of the grain-size distribution. The grain-size analysis is as follows:

U. S. Sieve Size No.	U. S. Sieve Size Opening, mm	% of Total Sample Passing
10	2.0	98.1
20	0.84	94.9
40	0.42	46.2
60	0.25	11.9
140	0.105	0.2
200	0.074	0.0

In qualitative terminology, this sand would be considered medium to fine grained.

Dugway Proving Ground (table 1, source 15)

43. Test shots 101 through 116 of the ERA Underground Explosion test program were made at a site located about 5 miles east of the Dugway Proving Ground base camp. The test area consisted of sand dunes with the difference in elevation between trough and crest being about 20 ft. The sand depth was greater than 100 ft. Lenses of clay and thin beds of white marl were present near the surface, and at lower depths some gravel lenses were present.

44. Although the site was referred to as a dry sand site, the data

obtained in tests therein have been placed in table 1 along with the data from the wet sand shots. Reference 15 states that damp sand was encountered at a depth of a few inches. Frequent rain squalls during the firing program maintained the moisture at this depth; however, the water table was believed to be somewhat deeper than 170 ft. Considerable moisture was encountered in the lenses of clay and the rather deep layers of cemented sand and gravel.

45. Results of seismic explorations indicated the seismic velocity to be 800 to 1000 fps in the dune sands, and 1500 to 2000 fps in the water-lain sands below. Seismic values of 8000 to 9000 fps were encountered below 100 ft. More specific data on the Dugway test area sand are given in table 8.

Camp Cooke
(table 1, source 32)

46. Test shots 301 through 310 of the Project Mole test program were detonated near Camp Cooke, California.

> "The test site is located on the banks of the lagoon formed at the mouth of the Santa Ynez River. This lagoon is blocked from the open sea by a sand bar and observations indicated that the water level did not vary measurably with daily tides or otherwise. The original ground surface at the test site was approximately 2 feet above water level and the soil consisted of silty sand mixed with organic matter for the first 2 feet, with saturated sand underlying the area. The test drilling showed that this sand was reasonably consistent to a depth of 20 feet where it was underlain by the so-called Monterey Shale. For the test series the original surface was removed by bulldozer in the vicinity of the shot points and blast lines so that the final surface was from 12 to 21 inches above the water table."[36]

Other data on this material are presented in table 8.

WES interface study
(table 1, source 41)

47. Test shots 31 and 32 of the WES soil-rock interface study were detonated at the WES Big Black test site. Data from test shots where the soil-rock interface influenced the shape of the crater (shots 33 through 36) were omitted from this report (see paragraph 26). The soil-rock interface was formed by a massive concrete slab with an overlying layer of sand

The sand was "pit run" and was kept in a saturated state (see table 8).

Marshall Islands
(table 1, source 53)

48. In 1952, HE shots were fired on Elugelab Island, Eniwetok Atoll, in material that is defined as a water-saturated coral sand. Apparently no detailed soil explorations were made at this site.

Dry-to-Moist Sand

Yucca Flats
(table 1, sources 2, 7)

49. The HE test shots of Operation JANGLE were fired at Yucca Flats of the Nevada test site. For all practical purposes, the test area was flat. The soil was defined as extremely fine, powderlike sand mixed with some gravel. The seismic velocity was 3000 fps to a depth of 100 ft. A summary of other soil information is presented in table 8.

Aberdeen Proving
Ground (table 1, source 6)

50. Test shots 5C1 through 1/4 C8 of the BRL spherical-charge test program were fired at Aberdeen Proving Ground in a large sand pit 48 in. deep. The average moisture content of the sand was 3.3 per cent. Apparently no further soil explorations were made at this site except for determination of the grain-size distribution, which was as follows:

U. S. Sieve Size No.	U. S. Sieve Size Opening, mm	% of Total Sample Passing
6	3.360	90.12
10	2.0	79.26
20	0.84	55.28
30	0.59	39.01
40	0.42	20.70
60	0.25	4.42
100	0.149	3.88
140	0.105	0.66
200	0.074	0.39

Qualitatively, this would be regarded as a coarse grade of sand.

Vicksburg dry sand
(table 1, source 40)

51. The dry-sand test se[illegible] conducted at the Big Black test

site in a rectangular pit approximately 10 by 10 by 2.5 ft. The sand was classified as being clean and well-graded. Care was taken to remold and recompact the sand after each shot to avoid appreciable density variations.

WES interface study
(table 1, source 41)

52. Test shots 1-21 of the WES soil-rock interface study were fired at the WES Big Black test site. Data from test shots where the soil-rock interface influenced the shape of the crater (shots 22-30) were omitted from table 1. The pit-run sand overlying the simulated soil-rock interface (see paragraph 47) had a density ranging from 97.6 to 109 lb per cu ft, and averaging 103 lb per cu ft. Moisture-content samples were taken at 0.5-, 1.5-, and 3.0-ft depths, and the average moisture contents for these respective depths were 4.4, 6.8, and 7.3 per cent. The over-all average moisture content was 6.6 per cent. Other soil data for this site are given in table 8.

Loess

Effects of Underground
Explosion tests, Natchez,
Mississippi (table 1, source 20)

53. All test shots detonated in loess during the Effects of Underground Explosions test program were fired at a site near Magnolia Bluff about 7 miles north of Natchez, Mississippi. Apparently no detailed soil explorations were made at this site except for seismic explorations. The moisture content of the soil, although not specifically reported, seemed to greatly affect seismic velocity; therefore, only the surface seismic velocity of 960 fps was considered accurate. The seismic velocity at lower depths varied considerably.

Vicksburg loess
(table 1, source 39)

54. These experimental tests were conducted in the northeast portion of the WES reservation. The loess in this area is very extensive and homogeneous. A quantitative description of the material is presented in table 9.

Various Soils

Vicksburg silt
(table 1, source 44)

55. Test shots 48-59 of the WES energy-partitioning test program were fired at the WES Big Black test site. The test area was about 100 by 200 ft. All shots were fired in undisturbed natural sandy silt soil. A summary of the soil data is presented in table 9.

Camp Gruber, Oklahoma (table 1, source 5)

56. Several test shots were detonated in various soil types during the UET program, a portion of which was conducted at Camp Gruber. The test site is located in Muskogee County, Oklahoma, approximately 14 miles southeast of Muskogee and 60 miles southeast of Tulsa.

> "The soils at the site are more or less heterogeneous and consist of all types of material ranging from fat silty clay to cohesionless clean sand. Water contents range from completely dry sand to saturated sandy silts and clays. In general, the more plastic materials are overlying the sandier materials...Geological investigations reported by the U. S. Geological Survey show that the tests were conducted in lacustrine terrace materials deposited during Pleistocene times. The bedrock consists of moderately dense sandstones and shales from the Winslow Formation of Pennsylvania Age."[5]

Princeton clay loam
(table 1, source 37)

57. During 1944, test shots to determine the effect of charge shape and orientation on craters in clay were detonated near the Ballistics Laboratory at Princeton University Station, Princeton, New Jersey. The soil was undisturbed, dry, hard, Sassafras clay loam. Apparently no detailed soil explorations were made at this site.

Frozen Ground

Keweenaw silt
(table 3, source 22)

58. All test shots in frozen Keweenaw silt were detonated in

northern Michigan. The test site, approximately 500 ft square, was free of stones and boulders and was uniform in composition. The silt was stratified with thin lenses of sand and organic deposits that were apparently not continuous. The soil classification showed the area to be predominantly silt and sandy silt. Plasticity tests indicated the soil to be, in general, nonplastic or of low plasticity. Preliminary exploration indicated that the silt layer was 7 ft deep. The moisture content of samples of the soil varied from approximately 30 per cent to slightly more than 100 per cent. A summary of the soil information from test shot 184 at this site is presented in table 9.

Fort Churchill till
(table 3; sources 23, 52)

59. Tests were conducted at sites located just south of the Churchill, Manitoba, airfield in 1955 and 1957. The test shots fired during the winter of 1955 were accomplished at two test sites, A and B, both in the same esker. Three explosive types, i.e. Composition C-3, Atlas 60, and Coalite 7-S (2- and 5-lb charges only), were detonated in the area designated as Blast Site A. At Blast Site B, 20-lb shots of Coalite 7-S were detonated.

60. Blast Site A consisted of a layer of gravel ranging from 6 to 10 in. in thickness, below which igneous and sedimentary boulders were dispersed at random in a matrix of unstratified frozen clay referred to as unstratified till. An average unit weight of 148.7 lb per cu ft was obtained from five large chunks of the unstratified till.

61. Blast Site B consisted of random layers of frozen vegetable matter over a 12- to 36-in. layer of frozen gravel with unstratified till below. The vegetable-matter layer, which contained ice lenses as much as 3 in. thick, had a maximum thickness of 12 in. The average weight of the frozen vegetable layer was 74.6 lb per cu ft. The average weight of the frozen gravel was 143.3 lb per cu ft.

62. The specific test site used during the 1957 test series is not described other than being at Fort Churchill.

Rock

Basalt, Panama Canal
Zone (table 4, source 46)

63. Test shots 1-10 and 14 of the Panama Canal basalt test program were fired in the area known as Cerro Lirio Quarry. Test shots 11-13 were detonated in the area known as Paja Quarry. Test shots 15(1A) through 18(4A) were detonated in the area known as Fort Kobbe Quarry.

> "The basalt is a dark gray, compact, very hard, fine-grained rock generally closely to moderately jointed and often showing columnar structure. It occurs in flows or as sills and dikes intruded into sedimentary rocks of early Miocene and older age. At Cerro Lirio Quarry it is a very hard, jointed basalt. Quarry blasting in the past apparently has superficially weakened the rock. The rock at Paja Quarry is one of the hardest basalts known in the vicinity of the Canal Zone. It is more closely jointed than the Basalt at Cerro Lirio and has a prominent columnar structure. The rock at the Fort Kobbe Quarry is a dark-gray to blue-black, very hard basalt, similar in abrasion resistance to the Paja Quarry rock. Joints are more widely spaced than average for Canal Zone basalts, and columnar structure is less prominent. Many of the joints contain a secondary filling of siliceous minerals, quartz and chalcedony."[46]

Niobrara chalk, site of Fort
Randall Dam (table 4, source 8)

64. All test shots in chalk during this U. S. Bureau of Mines test program were detonated at Fort Randall Dam site, Pickstown, South Dakota. A summary of the physical properties of the rock at this site is presented in table 10.

Unaweep granite, Grand Junction,
Colorado (table 4, sources 4, 13)

65. All test shots in granite during the Colorado School of Mines (CSM) Underground Explosion test program and the ERA Underground Explosion test program were detonated in Unaweep Canyon, about 25 road miles south of Grand Junction, Colorado. Two types of granite occurred at the test sites, a fine- to coarse-grained light-gray granite and a very coarse-grained granite. The CSM test shots were accomplished in the fine- to coarse-grained light-gray granite. The ERA shots were detonated in both types. A summary

of the physical properties of the rock is presented in table 10.

Granite, Lithonia,
Georgia (table 4, source 8)

66. All test shots in granite during the U. S. Bureau of Mines test program were detonated at the granite quarry of Consolidated Quarries Corporation, Lithonia, Georgia. A summary of the physical properties of the rock is presented in table 10.

Limestone, Dugway Proving
Ground (table 4, source 13)

67. Both test shots in limestone during the ERA Underground Explosion test program were detonated at a site located about 10 miles east of Dugway Proving Ground. The limestone site was not considered to be particularly desirable; however, no better site was found in any area investigated. The limestone had several fault zones, the largest of which occurred in the upper beds. The beds in this area ranged in thickness from 0.5 to 6.5 ft. The depth to the water table is unknown. The limestone was quite dry; however, some moisture was nearly always present along erosion channels. The seismic velocity ranged from 7000 to 12,500 fps and averaged 11,000 fps.

Navajo sandstone, Castle Dale,
Utah (table 4, sources 4, 14)

68. All test shots in sandstone during the CSM and the ERA Underground Explosion test programs were detonated in the upper part of the Navajo sandstone near Castle Dale, Utah. The CSM test program was conducted about 23 miles east of Castle Dale, Utah, on the northwest flank of the San Rafael swell. The ERA test program was conducted about 16 miles east of Castle Dale, Utah, in Buckhorn Wash.

69. The primary structural feature of both test sites was the numerous sets of extensive joint systems. Both sites consisted of prominent joints striking and dipping in various directions. The exposed rock in the areas lose moisture due to evaporation; however, the unexposed rock maintain a small amount of moisture. Because of the wide variations in physical properties of the sandstone, specific values of these properties are not included in this report.

<u>Green River marlstone, Rifle, Colorado (table 4, source 8)</u>

70. All test shots in marlstone in this U. S. Bureau of Mines test program were detonated at the Experimental Oil-Shale Mine, Bureau of Mines, Rifle, Colorado. A summary of the physical properties of the rock is presented in table 10.

<u>Kanawha sandstone, Pennsylvania (table 4, source 8)</u>

71. All test shots in sandstone in this U. S. Bureau of Mines test program were detonated at Seifer Farm and Eakin Quarry near Franklin, Pennsylvania. A summary of the physical properties of the rock is presented in table 10.

<u>Culebra sandstone, Panama Canal Zone (table 4, source 47)</u>

72. The two test shots in Culebra sandstone during the Panama Canal test series were detonated on the west bank of the canal near stations 1750 and 1760. The test site was in the upper member of the Culebra formation. The formation is composed of beds and lenses of gray to buff, calcareous and tuffaceous sandstones, 3 to 10 ft in thickness. Apparently no additional rock information was obtained at the test site.

<u>Gatun sandstone, Panama Canal Zone (table 4, source 48)</u>

73. All test shots in Gatun sandstone during the Panama Canal test series were detonated at the south plug of the Gatun Third Locks excavation.

> "The Gatun formation is composed largely of argillaceous, variably calcareous, fine-grained sandstones interbedded with fine-textured volcanic tuffs and occasional thin conglomerate beds. Bedding in the formation is massive and remarkably uniform, with individual beds attaining thicknesses of 100 ft or more. The variably calcareous nature of the formation was conspicuous in the bed used for the crater tests, where numerous small masses of hard, well-cemented sandstone graded into the surrounding medium-hard slightly-cemented sandstone. The abundance of fossils show that this formation represents the produce of marine deposition of middle Miocene age."[48]

Shale, Panama Canal
Zone (table 4, source 47)

74. All test shots in shale during the Panama Canal test series were detonated in the Cucaracha and Culebra formations on the west bank of the canal near stations 1750 and 1760.

> "The Cucaracha formation consists of weak, locally bentonitic clay shales interbedded with fine, tuffaceous siltstones; medium- to coarse-grained, tuffaceous sandstones; pebble conglomerates; thinly bedded, black, carbonaceous, clayey shales; and a hard, gray agglomeratic tuff known as the 'ash flow.' The clay shales, which are predominant, consist of compact, medium hard, variably waxy or soapy, massively bedded, altered tuffs. A characteristic feature of the clay shale is the presence of irregular, smoothly-polished, minute fractures or slickensides. The color is mainly greenish gray, but some lenses within the clay shales are red brown to chocolate hues."[47]

The two shots fired in the upper member of the Culebra formation were detonated in shale although the formation is composed mainly of sandstone.

Ice

Camp TUTO, Greenland
(table 5, source 51)

75. Cratering test shots were detonated in Greenland in 1957 at a site approximately 3 miles east of Camp TUTO. Camp TUTO is located approximately 12 miles east of Thule AFB. The depth of the ice was greater than 100 ft and its density averaged 55.6 lb per cu ft.

Snow

Alta, Utah
(table 6, source 19)

76. In 1956 the U. S. Snow Ice and Permafrost Research Establishment conducted tests near Alta, Utah, in a snow blanket 110 to 120 in. deep.

Camp Hale, Colorado
(table 6, source 38)

77. The three crater test shots of the 1958 WES snow test program

were fired at Camp Hale, Colorado. The snow was 4 ft deep, with the upper 1.5 ft composed of dry snow and the lower 2.5 ft composed of icy snow. The unit weights of the dry snow and the icy snow were 8 lb per cu ft and 12.2 lb per cu ft, respectively.

BIBLIOGRAPHY

1. Anderson, F. W., Capt., U. S. Army, Crater Dimensions from Experimental Data (CONFIDENTIAL-Restricted Data). FWE-18, Ministry of Home Security, Research and Experiments Department, September 1942 (TIS Issuance Date, 1 October 1954).

2. Campbell, Donald C., LCdr., U. S. Navy, Some HE Tests and Observations on Craters and Base Surges, Project 1(9)-3, Operation JANGLE (UNCLASSIFIED). WT 410, Armed Forces Special Weapons Project, 1 November 1951, part of High Explosives Tests, Operation JANGLE (UNCLASSIFIED), WT-365.

3. Christensen, Wayne J., Cdr., CEC, U. S. Navy, Cratering from Atomic Weapons (SECRET-FRD). AFSWP 514, Weapons Effects Division, Headquarters, Armed Forces Special Weapons Project, Washington, D. C., 29 June 1956.

4. Colorado School of Mines, Underground Explosion Test Program; Series I and Series II Experiments (UNCLASSIFIED). Golden, Colo., 1 December 1948.

5. Committee on Fortification Design, National Research Council, Effects of Underground Explosions; Resulting Damage to Structures (RESTRICTED). Vol III, No. 26, Interim Report to the Chief of Engineers, U. S. Army, June 1944.

6. Conant, David, and Swineford, James, Cratering in Sand from Spherical Charges (UNCLASSIFIED). Memorandum Report No. 669, Ballistic Research Laboratory, May 1953.

7. Doll, E. B., and Salmon, V., Scaled HE Tests, Project 1(9)-1, Operation JANGLE (SECRET-Restricted Data). Final Report, AFSWP 123, Stanford Research Institute, Stanford, Calif., December 1952.

8. Duvall, Wilbur I., and Atchison, Thomas C., Rock Breakage by Explosives (UNCLASSIFIED). Report of Investigation 5356, Applied Physics Laboratory, Bureau of Mines, College Park, Md., September 1957.

9. Engineering Research Associates, Inc., Instrumentation for Underground Explosion Test Program; Dry Clay (CONFIDENTIAL). Interim Technical Report No. 1, report for Sacramento District, CE, Department of Army, 1 August 1951.

10. ________, Instrumentation for Underground Explosion Test Program; Dry Sand (CONFIDENTIAL). Interim Technical Report No. 2, report for Sacramento District, CE, Department of Army, 1 October 1951.

11. ________, Instrumentation for Underground Explosion Test Program; Wet Clay (CONFIDENTIAL). Interim Technical Report No. 3, report for Sacramento District, CE, Department of Army, 1 November 1951.

12. Engineering Research Associates, Inc., Instrumentation for Underground Explosion Test Program; Dry Clay; Dry Sand; and Wet Clay (CONFIDENTIAL). Supplement to Interim Technical Reports Nos. 1, 2, and 3, vol I, report for Sacramento District, CE, Department of Army, 1 June 1952.

13. ________, Underground Explosion Test Program; Granite and Limestone (CONFIDENTIAL). Technical Report No. 4, vol I, report for Sacramento District, CE, Department of Army, 30 August 1952.

14. ________, Underground Explosion Test Program; Sandstone (CONFIDENTIAL). Technical Report No. 5, vol I, report for Sacramento District, CE, Department of Army, 15 February 1953.

15. ________, Underground Explosion Test Program; Soil (CONFIDENTIAL). Final Report, vol I, report for Sacramento District, CE, Department of Army, 30 August 1952.

16. ________, Underground Explosion Test Program; Rock (CONFIDENTIAL). Final Report, vol II, report for Sacramento District, CE, Department of Army, 30 April 1953.

17. Fano, U., Weight of Material Required to Fill Bomb Craters (Model Experiments) (UNCLASSIFIED). BRL Report No. 488, Ballistic Research Laboratories, Aberdeen Proving Ground, Md., 21 September 1944.

18.* Ferrett Committee, Terminal Report for Project Ferrett (SECRET-Restricted Data). NOLR 1191, U. S. Naval Ordnance Laboratory, White Oak, Md., 1 March 1954.

19. Fuchs, Alfred, Effects of Explosives on Snow (UNCLASSIFIED). Special Report 23, U. S. Army Snow Ice and Permafrost Research Establishment, CE, Wilmette, Ill., July 1957.

20. Lampson, C. W., Effects of Underground Explosions, IV (RESTRICTED). OSRD 6304, NDRC A-359, Division 2, National Defense Research Committee of the Office of Scientific Research and Development, approved 21 February 1946.

21. ________, Final Report on Effects of Underground Explosion (UNCLASSIFIED). OSRD 6645, NDRC A-479, Division 2, National Defense Research Committee of the Office of Scientific Research and Development, approved March 1946.

22. Livingston, C. W., Excavations in Frozen Ground; Part I, Explosion Tests in Keweenaw Silt (UNCLASSIFIED). SIPRE Report 30, prepared for U. S. Army Snow Ice and Permafrost Research Establishment, CE, Wilmette, Ill., July 1956.

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* See paragraph 6 of text.

23. Livingston, C. W., Fort Churchill Blast Tests; Blasts in Frozen Glacial Till (UNCLASSIFIED). Vol II, prepared for U. S. Army Snow Ice and Permafrost Research Establishment, CE, Wilmette, Ill., September 1956.

24. Mann, R. L., Cdr., U. S. Navy, Igloo and Revetment Tests (UNCLASSIFIED). Technical Paper No. 5, Army-Navy Explosives Safety Board, Washington, D. C., October 1946.

25. _________, Scale Model Igloo Magazine Explosion Tests (UNCLASSIFIED). Technical Paper No. 4, Army-Navy Explosives Safety Board, Washington, D. C., August 1946.

26.* Merritt, J. L., McDonough, G. F., Jr., and Newmark, N. M., Evaluation of Data from Underground Explosion Tests in Soil (CONFIDENTIAL-FRD). Structural Research Series No. 152, Department of Civil Engineering, University of Illinois, Urbana, Ill., May 1958.

27.* Merritt, J. L., Woodling, R. E., McDonough, G. F., and Kurtz, M. K., Summary of Data from Underground Explosion Tests in Soil (SECRET-Restricted Data). University of Illinois, Urbana, Ill., 15 January 1955.

28. Miles, F. H., Jr., Col., U. S. Army, Igloo Tests (UNCLASSIFIED). Technical Paper No. 3, Army-Navy Explosives Safety Board, Washington, D. C., 1945.

29.* Perkins, Beauregard, Jr., True Crater Dimensions in Various Soils and Rock (A Summary of Available HE Data) (CONFIDENTIAL). Memorandum Report No. 773, Ballistic Research Laboratories, Aberdeen Proving Ground, Md., March 1954.

30. Road Research Laboratory, A Comparison of the Crater Dimensions and Permanent Earth Movements in Clay, Sand, Chalk, and Gravel Soils Due to the Explosion of Buried Bombs (SECRET). R.C. 199, EAC 59, Ministry of Home Security, March 1941.

31. Robinson, C. S., Explosions, Their Anatomy and Destructiveness (UNCLASSIFIED). McGraw-Hill Book Company, Inc., New York, N. Y., 1944.

32. Sachs, D. C., and Swift, L. M., Small Explosion Tests, Project Mole (CONFIDENTIAL). Vols I and II, AFSWP 291, Stanford Research Institute, Menlo Park, Calif., December 1955.

33. _________, Small Explosion Tests, Phase II-B of Project Mole (CONFIDENTIAL-Restricted Data). AFSWP 290, Stanford Research Institute, Stanford, Calif., December 1954.

* See paragraph 6 of text.

34.* Shnider, R., Compilation of Crater Data from Surface and Underground Explosions (CONFIDENTIAL). Research and Development Technical Report USNRDL-TR-212, U. S. Naval Radiological Defense Laboratory, San Francisco, Calif., 5 March 1958.

35. Stevens, Garth, Maj., U. S. Army, The Behavior of the Shock Wave in Air from Small Underground Explosives (CONFIDENTIAL). NAVORD Report 1863, U. S. Naval Ordnance Laboratory, White Oak, Md., 26 April 1951.

36. Swift, L. M., and Sachs, D. C., Small Explosion Tests; Phase II of Project Mole (CONFIDENTIAL-FRD). Second Interim Report, AFSWP 289, Stanford Research Institute, Stanford, Calif., May 1954.

37. Tan, E. J., Effects of Charge Shape and Orientation on Cratering in Soil (CONFIDENTIAL). NO-263, Princeton University, 25 October 1944, part of Air and Earth Shock, vol 3, Monthly Report No. AES-3 (OSRD No. 4257), Division 2, National Defense Research Committee, 15 September to 25 October 1944.

38. U. S. Army Engineer Waterways Experiment Station, CE, Blast-Pressure Measurements in Snow (UNCLASSIFIED). Miscellaneous Paper No. 2-274, Vicksburg, Miss., June 1958.

39. ________, Cratering Effects of Surface and Buried HE Charges in Loess and Clay (UNCLASSIFIED). Technical Report No. 2-482, Vicksburg, Miss., June 1958.

40. ________, Cratering in Dry Sand (UNCLASSIFIED). Miscellaneous Paper (in preparation), Vicksburg, Miss.

41. ________, Effects of a Soil-Rock Interface on Cratering (UNCLASSIFIED). Technical Report No. 2-478, AFSWP 1056, Vicksburg, Miss., May 1958.

42. ________, Effects of Stemming on Underground Explosions (UNCLASSIFIED). Technical Report No. 2-438, AFSWP 823, Vicksburg, Miss., January 1957.

43. ________, Stemming Effects for Certain HE Charges (UNCLASSIFIED). Miscellaneous Paper No. 2-192, AFSWP 1003, Vicksburg, Miss., March 1957.

44. ________, Study of Energy Partitioning for Partially Confined Explosives (UNCLASSIFIED). Technical Memorandum No. 2-422, AFSWP 788, Vicksburg, Miss., November 1955.

45. U. S. Special Engineering Division, The Panama Canal, Crater and Slope Tests with Explosives (UNCLASSIFIED). ICS Memo 282-P, Diablo Heights, Canal Zone, 8 June 1948.

---

* See paragraph 6 of text.

46. U. S. Special Engineering Division, The Panama Canal, Crater Tests in Basalt (UNCLASSIFIED). ICS Memo 284-P, Diablo Heights, Canal Zone, 26 April 1948.

47. ________, Crater Tests in Cucaracha and Culebra Formations (UNCLASSIFIED). ICS Memo 283-P, Diablo Heights, Canal Zone, 30 April 1948.

48. ________, Crater Tests in Gatun Sandstone (UNCLASSIFIED). ICS Memo 285-P, Diablo Heights, Canal Zone, 14 May 1948.

49. ________, Crater Tests in Marine Muck (UNCLASSIFIED). ICS Memo 286-P, Diablo Heights, Canal Zone, 8 June 1948.

50. ________, Crater Tests in Residual Clay (UNCLASSIFIED). ICS Memo 287-P, Diablo Heights, Canal Zone, 18 May 1948.

51. Unpublished Data on Explosions in Ice (UNCLASSIFIED). Tests conducted in Greenland, summer 1957. U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

52. Unpublished Data on Investigation of Charge Shape (UNCLASSIFIED). Tests conducted at Fort Churchill, February-March 1957. U. S. Army Snow Ice and Permafrost Research Establishment, Wilmette, Ill.

53. Vaile, R. B., Crater Survey, Project 3.2, Operation CASTLE (SECRET-FRD). WT 920, Stanford Research Institute, Stanford, Calif., June 1955.

54. ________, Small Explosion Tests, Phase I of Project Mole (CONFIDENTIAL-FRD). AFSWP 288, Stanford Research Institute, Stanford, Calif., December 1952.

Table 1

Results of Crater Measurements in Soil

(1 of 24 sheets)

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
						Shots Fired in Clay											
Wet clay																	
1	32	313	TNT	256	256	6.35	+0.83	+0.13	3.40	6.1		38	163.3				
2	49	15	TNT	25	25	2.92	0.0	0.0	3.86	5.66	0.95	58	217.0				
3	49	16(1A)	TNT	50	50	3.68	0.0	0.0	5.00	7.2		69	484.0				
4	49	17(2A)	TNT	50	50	3.68	0.0	0.0	5.00	7.65		74	459.0				
5	20	B-62	TNT	64	64	4.00	0.0	0.0		3.36							
6	15	402	TNT	320	320	6.84	-2.5	-0.37	10.00	18.75		44	4,100		23.5		
7	15	404	TNT	320	320	6.84	-2.5	-0.37	11.50	17.5		44	3,900		24.0		
8	15	403	TNT	2,560	2,560	13.68	-5.0	-0.37	12.75	41.75		41	29,000		45.25		
9	49	1	TNT	8	8	2	-1.0	-0.50	4.28	5.22	1.55	75	232				
10	32	311	TNT	256	256	6.35	-3.15	-0.50	11.2	15.5		47	3,147.5				
11	32	312	TNT	256	256	6.35	-3.15	-0.50	9.10	17.5		39	3,345.3				
12	49	5	TNT	25	25	2.92	-1.5	-0.51	6.65	8.86	1.25	49	704				
13	20	B-60	TNT	64	64	4.0	-2.1	-0.52		8.00							
14	20	B-61	TNT	64	64	4.0	-2.1	-0.52		8.00							
15	20	C-42	TNT	64	64	4.0	-2.1	-0.52		8.00							
16	20	C-43	TNT	64	64	4.0	-2.1	-0.52		10.00							
17	49	12	TNT	75	75	4.22	-4.0	-0.95	9.30	12.56	2.08	49	2,030				
18	49	6	TNT	25	25	2.92	-3.0	-1.03	6.60	9.07	0.90	57	876				
19	20	B-21	TNT	64	64	4.0	-4.2	-1.05		10.5							
20	20	C-40	TNT	64	64	4.0	-4.2	-1.05		10.0							
21	20	C-41	TNT	64	64	4.0	-4.2	-1.05	7.0	10.0		42	1,400	11.5	13.0	55	2,900
22	20	C-44	TNT	64	64	4.0	-4.2	-1.05		10.0							
23	20	C-45	TNT	64	64	4.0	-4.2	-1.05		9.5							
24	20	C-46	TNT	64	64	4.0	-4.2	-1.05		9.5							
25	20	C-47	TNT	64	64	4.0	-4.2	-1.05		9.0							
26	20	C-49	TNT	64	64	4.0	-4.2	-1.05		10.0							

* Numbers correspond to Bibliography numbers.

Table 1 (Continued) (2 of 24 sheets)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
			Shots Fired in Clay (Continued)														
Wet clay (Continued)																	
27	20	C-58	TNT	64	64	4.0	-4.2	-1.05		9.0							
28	20	C-59	TNT	64	64	4.0	-4.2	-1.05		9.5							
29	20	X-1	TNT	64	64	4.0	-4.2	-1.05		10.7							
30	20	X-5	TNT	64	64	4.0	-4.2	-1.05		9.9							
31	20	X-6	TNT	64	64	4.0	-4.2	-1.05		11.9							
32	20	X-7	TNT	64	64	4.0	-4.2	-1.05		10.75							
33	20	X-8	TNT	64	64	4.0	-4.2	-1.05		10.3							
34	20	X-9	TNT	64	64	4.0	-4.2	-1.05		9.9							
35	20	X-10	TNT	64	64	4.0	-4.2	-1.05		9.9							
36	15	401	TNT	8	8	2	-2.5	-1.25	5.0	7.0		47	310		10.0		
37	15	405	TNT	8	8	2	-2.5	-1.25	4.10	6.0		51	270		8.0		
38	49	2	TNT	8	8	2	-3.0	-1.50	5.10	6.60	0.98	41	257				
39	49	7	TNT	25	25	2.92	-4.5	-1.54	6.20	7.74	2.00	101	737				
40	20	B-19	TNT	64	64	4.0	-6.3	-1.58		11.0							
41	20	B-20	TNT	64	64	4.0	-6.3	-1.58		11.0							
42	20	C-34	TNT	64	64	4.0	-6.3	-1.58		10.0							
43	20	C-35	TNT	64	64	4.0	-6.3	-1.58	7.0	10.0		60	1,360	11.5	14.0	46	3,600
44	20	X-14	TNT	64	64	4.0	-6.3	-1.58		7.5							
45	20	X-15	TNT	64	64	4.0	-6.3	-1.58		7.75							
46	20	X-16	TNT	64	64	4.0	-6.3	-1.58		7.20							
47	20	X-17	TNT	64	64	4.0	-6.3	-1.58		8.00							
48	20	X-19	TNT	64	64	4.0	-6.3	-1.58		6.72							
49	20	X-20	TNT	64	64	4.0	-6.3	-1.58		7.80							
50	20	X-21	TNT	64	64	4.0	-6.3	-1.58		6.50							
51	20	X-22	TNT	64	64	4.0	-6.3	-1.58		5.20							

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired in Clay (Continued)												
Wet clay (Continued)																	
52	20	X-23	TNT	64	64	4.0	-6.3	-1.58		6.50							
53	20	B-22	TNT	64	64	4.0	-6.4	-1.60		10.32							
54	20	A-1	TNT	64	64	4.0	-7.0	-1.75		13.00							
55	20	A-3	TNT	64	64	4.0	-7.5	-1.88		13.64							
56	49	8	TNT	25	25	2.92	-6.0	-2.05	6.05	6.51	2.50	74	574				
57	49	14	TNT	200	200	5.85	-12.0	-2.05	2.50	33.11	0.58		3,410				
58	20	A-2	TNT	64	64	4.0	-8.4	-2.10		12.50							
59	20	A-4	TNT	64	64	4.0	-8.4	-2.10		12.84							
60	20	A-5	TNT	64	64	4.0	-8.4	-2.10		14.16							
61	20	A-6	TNT	64	64	4.0	-8.4	-2.10		13.84							
62	20	A-7	TNT	64	64	4.0	-8.4	-2.10		12.00							
63	20	A-8	TNT	64	64	4.0	-8.4	-2.10		10.00							
64	20	A-9	TNT	64	64	4.0	-8.4	-2.10		12.00							
65	20	A-10	TNT	64	64	4.0	-8.4	-2.10		11.50							
66	20	A-24	TNT	64	64	4.0	-8.4	-2.10		12.00							
67	20	A-25	TNT	64	64	4.0	-8.4	-2.10		11.16							
68	20	B-16	TNT	64	64	4.0	-8.4	-2.10		11.50							
69	20	B-18	TNT	64	64	4.0	-8.4	-2.10		10.00							
70	20	B-27	TNT	64	64	4.0	-8.4	-2.10		10.50							
71	20	C-32	TNT	64	64	4.0	-8.4	-2.10		11.00							
72	20	C-33	TNT	64	64	4.0	-8.4	-2.10		12.64							
73	20	C-36	TNT	64	64	4.0	-8.4	-2.10		11.00							
74	20	C-37	TNT	64	64	4.0	-8.4	-2.10	5.80	12.50		64	900	14.3	14.25	51	3,800
75	20	C-50	TNT	64	64	4.0	-8.4	-2.10		9.50							
76	20	C-51	TNT	64	64	4.0	-8.4	-2.10		11.00							
77	20	C-56	TNT	64	64	4.0	-8.4	-2.10		10.00							

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
			Shots Fired in Clay (Continued)														
Wet clay (Continued)																	
78	20	C-57	TNT	64	64	4.0	-8.4	-2.10		9.50							
79	49	3	TNT	8.0	8.0	2.0	-5.0	-2.50	1.60	8.87	0.45		163				
80	49	9	TNT	25	25	2.92	-7.5	-2.57	3.00	10.96	0.98		446				
81	49	13	TNT	75	75	4.22	-12.0	-2.84	2.63	19.51	0.88		1,310				
82	20	C-29	TNT	64	64	4.0	-11.6	-2.90		10.50							
83	49	10	TNT	25	25	2.92	-9.0	-3.08	1.98	11.85	1.00		402				
84	20	B-14	TNT	64	64	4.0	-12.6	-3.15		10.00							
85	20	B-15	TNT	64	64	4.0	-12.6	-3.15		10.00							
86	20	B-17	TNT	64	64	4.0	-12.6	-3.15		8.50							
87	20	B-26	TNT	64	64	4.0	-12.6	-3.15		8.84							
88	20	C-28	TNT	64	64	4.0	-12.6	-3.15		8.00							
89	20	C-38	TNT	64	64	4.0	-12.6	-3.15		9.00							
90	20	C-39	TNT	64	64	4.0	-12.6	-3.15	3.10	9.50			470	16.4	12.0	42	3,400
91	20	C-52	TNT	64	64	4.0	-12.6	-3.15		9.50							
92	20	C-53	TNT	64	64	4.0	-12.6	-3.15		8.50							
93	20	C-54	TNT	64	64	4.0	-12.6	-3.15		8.00							
94	20	C-55	TNT	64	64	4.0	-12.6	-3.15		9.00							
95	49	4	TNT	8.0	8.0	2.0	-7.0	-3.50	3.14	4.52	1.55	79	138				
96	20	B-11	TNT	64	64	4.0	-14.3	-3.58		4.92							
97	49	11	TNT	25	25	2.92	-10.5	-3.60	2.93	11.27	1.51		291				
98	20	B-12	TNT	64	64	4.0	-16.8	-4.20		4.00							
99	20	B-13	TNT	64	64	4.0	-16.8	-4.20		4.44							
100	20	C-30	TNT	64	64	4.0	-16.8	-4.20		4.50							
101	20	C-31	TNT	64	64	4.0	-16.8	-4.20		5.60							

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired in Clay (Continued)												
Moist clay																	
102	39	57	C-4	1.0	1.0	1.0	0.0	0.0	0.65	1.50	0.05	23	1.63	0.89	1.50	23	2.37
103	50	6	TNT	25	25	2.92	0.0	0.0	2.10	3.80		29	32.9	2.50	4.49	44	57.8
104	44	EL-31	Dynamite**	54	36.8	3.32	-1.5	-0.45	3.80	6.00	0.44	41	175	5.45	7.00	39	295
105	44	EL-32	Dynamite†	54	36.8	3.32	-1.5	-0.45	3.60	6.00	0.43	38	170	5.35	6.50	35	256
106	44	EL-34	Dynamite**	54	36.8	3.32	-1.5	-0.45	3.35	6.70	0.50	41	199	5.70	7.50	39	367
107	44	EL-35	Dynamite†	54	36.8	3.32	-1.5	-0.45	4.25	6.60	0.55	38	224	5.37	7.50	35	333
108	44	EL-36	Dynamite**	54	36.8	3.32	-1.5	-0.45	4.60	7.00	0.55	41	289	6.10	8.00	39	426
109	44	EL-37	Dynamite†	54	36.8	3.32	-1.5	-0.45	4.00	6.50	0.65	38	224	5.30	7.00	35	304
110	44	EL-38	Dynamite**	54	36.8	3.32	-1.5	-0.45	4.40	7.00	0.55	41	277	5.78	7.50	39	386
111	44	EL-39	Dynamite†	54	36.8	3.32	-1.5	-0.45	4.10	6.45	0.58	38	214	5.60	6.50	35	290
112	44	EL-40	Dynamite**	54	36.8	3.32	-1.5	-0.45	3.80	6.50	0.65	41	189	5.60	6.50	39	303
113	44	EL-41	Dynamite†	54	36.8	3.32	-1.5	-0.45	3.60	6.10	0.45	38	162	4.90	6.50	35	255
114	44	EL-47	Dynamite**	54	36.8	3.32	-1.5	-0.45	4.30	7.60	0.95	41	345	5.68	8.50	39	527
115	44	EL-10	C-4**	27	27	3.00	-1.5	-0.50	4.50	6.65	0.50	38	262	5.40	6.65	27	345
116	44	EL-11	C-4†	27	27	3.00	-1.5	-0.50	3.35	6.50	0.50	37	154	4.85	6.50	27	237
117	44	EL-15	C-4**	27	27	3.00	-1.5	-0.50	4.45	6.40	0.38	38	227	5.50	7.00	27	347
118	44	EL-16	C-4†	27	27	3.00	-1.5	-0.50	3.20	5.40	0.23	37	124	5.02	6.00	27	213
119	44	EL-20	C-4**	27	27	3.00	-1.5	-0.50	4.00	6.80	0.43	38	213	5.55	7.50	27	344
120	44	EL-21	C-4†	27	27	3.00	-1.5	-0.50	4.00	6.70	0.50	37	229				
121	44	EL-33	C-4**	27	27	3.00	-1.5	-0.50	4.25	6.10	0.54	38	196	5.40	6.50	27	278
122	50	1	TNT	25	25	2.92	-1.5	-0.51	2.95	4.69		42	93.6	4.20	5.41	40	145
123	43	A-1	C-4†	27	27	3.00	-2.25	-0.75	3.20	6.50	0.56	31	152	5.55	7.50	50	370
124	43	A-2	C-4†	27	27	3.00	-2.25	-0.75	3.40	6.00	0.64	50	190	5.42	7.50	43	354
125	43	A-3	C-4**	27	27	3.00	-2.25	-0.75	3.70	6.50	0.60	41	227	5.65	7.50	47	401
126	43	A-4	C-4**	27	27	3.00	-2.25	-0.75	3.15	6.00	0.66	40	167	5.25	6.50	49	298
127	42	S-22	Dynamite†	54	36.8	3.32	-3.0	-1.00	3.30	7.50	0.49	32	275	6.60	8.50	42	556

** Stemmed. † Unstemmed.

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_{a_c} CU FT	CRATER DIMENSIONS TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_{t_c} CU FT
					Shots Fired in Clay (Continued)												
Moist clay (Continued)																	
128	42	S-23	Dynamite†	54	36.8	3.32	-3.0	-0.90	4.00	7.50	0.56	27	285	6.55	8.00	43	510
129	42	S-24	Dynamite†	54	36.8	3.32	-3.0	-0.90	4.40	7.50	0.47	34	332	6.60	8.00	60	530
130	42	S-25	Dynamite††	54	36.8	3.32	-3.0	-0.90	4.90	8.50	0.59	48	458	6.70	9.00	55	71[illegible]
131	42	S-26	Dynamite††	54	36.8	3.32	-3.0	-0.90	4.90	8.50	0.71	42	455	6.90	9.00	52	731
132	42	S-27	Dynamite††	54	36.8	3.32	-3.0	-0.90	5.00	7.50	0.48	35	403	6.70	8.50	64	693
133	42	S-28	Dynamite**	54	36.8	3.32	-3.0	-0.90	5.60	8.00	0.60	37	476	6.70	9.00	41	657
134	42	S-29	Dynamite**	54	36.8	3.32	-3.0	-0.90	5.10	8.50	0.48	39	481	6.90	9.00	47	706
135	39	56	C-4	1.0	1.0	1.00	-1.0	-1.0	1.30	2.30	0.16	27	3.39	2.05	2.30	45	14.0
136	44	EL-8	C-4**	27	27	3.00	-3.0	-1.0	3.40	6.60	0.45	40	196				
137	44	EL-9	C-4†	27	27	3.00	-3.0	-1.0	3.00	6.15	0.55	33	127	6.50	6.50	32	332
138	44	EL-12	C-4†	27	27	3.00	-3.0	-1.0	2.75	6.0	0.45	30	114	5.95	6.0	23	259
139	44	EL-13	C-4**	27	27	3.00	-3.0	-1.0	4.40	6.75	0.45	40	276	6.40	7.50	37	446
140	44	EL-14	C-4†	27	27	3.00	-3.0	-1.0	3.35	6.00	0.25	33	150	6.12	7.00	32	289
141	44	EL-17	C-4†	27	27	3.00	-3.0	-1.0	2.95	5.80	0.28	30	118	6.24	6.00	23	264
142	44	EL-18	C-4**	27	27	3.00	-3.0	-1.0	4.33	7.30	0.70	40	282	7.10	7.50	37	464
143	44	EL-19	C-4†	27	27	3.00	-3.0	-1.0	3.45	6.15	0.52	33	174	6.40	7.00	32	330
144	44	EL-22	C-4†	27	27	3.00	-3.0	-1.0	3.30	6.00	0.65	30	146	6.30	7.00	23	318
145	44	EL-23	C-4**	27	27	3.00	-3.0	-1.0	3.90	6.70	0.55	40	230	6.65	7.00	37	373
146	44	EL-24	C-4†	27	27	3.00	-3.0	-1.0	2.20	5.30	0.48	33	80	6.00	6.00	32	230
147	42	S-8	C-4†	27	27	3.00	-3.0	-1.0	2.20	6.00	0.56	26	104	5.45	6.70	52	273
148	42	S-9	C-4†	27	27	3.00	-3.0	-1.0	2.75	5.80	0.50	33	128	5.65	6.85	43	254
149	42	S-10	C-4†	27	27	3.00	-3.0	-1.0	2.80	5.75	0.62	34	127	5.60	6.35	57	290
150	42	S-11	C-4††	27	27	3.00	-3.0	-1.0	3.20	6.70	0.70	27	186	6.25	8.00	61	491
151	42	S-12	C-4††	27	27	3.00	-3.0	-1.0	3.35	7.00	0.69	34	213	6.30	8.00	20	499
152	42	S-13	C-4††	27	27	3.00	-3.0	-1.0	2.80	6.60	0.69	31	169	6.20	7.35	49	349
153	42	S-14	C-4††	27	27	3.00	-3.0	-1.0	3.00	6.50	0.80	43	178	6.00	7.50	46	413

** Stemmed. † Unstemmed. †† 1/3 stemmed.

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired in Clay (Continued)												
Moist clay (Continued)																	
154	42	S-15	C-4‡	27	27	3.00	-3.0	-1.0	3.10	6.50	0.63	32	182	6.25	7.50	56	409
155	42	S-16	C-4‡	27	27	3.00	-3.0	-1.0	3.40	6.75	0.58	31	181	6.30	7.15	50	392
156	42	S-17	C-4‡	27	27	3.00	-3.0	-1.0	3.90	7.00	0.42	30	234	6.00	8.00	48	486
157	42	S-18	C-4**	27	27	3.00	-3.0	-1.0	4.70	7.00	0.50	34	298	6.20	7.50	56	459
158	42	S-19	C-4**	27	27	3.00	-3.0	-1.0	4.00	6.90	0.50	32	223	6.20	7.50	58	450
159	42	S-20	C-4**	27	27	3.00	-3.0	-1.0	4.10	7.00	0.58	40	249	6.10	7.50	75	402
160	42	S-21	C-4‡‡	27	27	3.00	-3.0	-1.0	4.00	6.50	0.66	41	230	6.10	7.00	48	379
161	50	5	TNT	200	200	5.85	-6.0	-1.03	9.43	16.94		44	3,550				
162	50	7	TNT	25	25	2.92	-4.5	-1.54	3.18	7.26		35	213	7.25	9.77	54	1,410
163	50	4	TNT	75	75	4.22	-8.0	-1.90	5.00	10.95		29	747				
164	39	58	C-4	1.0	1.0	1.00	-2.0	-2.00	-0.44§	2.50	0.20	27		3.11	2.50	84	27.6
165	39	68	C-4	1.0	1.0	1.00	-2.25	-2.25	-0.18§	4.50	0.32	18		3.26	3.00	47	35.6
166	39	69	C-4	1.0	1.0	1.00	-2.50	-2.50	-0.50§	4.00		21		3.59	3.00	66	38.6
167	50	3	TNT	8.0	8.0	2.00	-5.0	-2.50	1.68	4.35		47	48.8	6.35	5.40	53	233
168	39	70	C-4	1.0	1.0	1.00	-2.75	-2.75	-0.85§	3.50		25		3.73	2.80	62	33.4
169	50	2	TNT	75	75	4.22	-12.0	-2.84	1.95	12.32		22	374				
170	39	59	C-4	1.0	1.0	1.00	-3.00	-3.00	-1.54§	3.50		32		4.05	2.50	35	19.5
171	39	60	C-4	1.0	1.0	1.00	-3.50	-3.50	-0.58§	3.50		22		See Table 2 (Camouflets)			
172	50	8	TNT	8.0	8.0	2.00	-7.0	-3.50	2.50	3.51		62	56.1				
173	39	71	C-4	1.0	1.0	1.00	-3.90	-3.90									
174	39	61	C-4	1.0	1.0	1.00	-4.00	-4.00	-0.19§	3.00		19		See Table 2 (Camouflets)			
175	39	72	C-4	1.0	1.0	1.00	-4.25	-4.25	-0.50§	4.00		21		See Table 2 (Camouflets)			
176	39	62	C-4	1.0	1.0	1.00	-4.50	-4.50	-0.12§	3.50				See Table 2 (Camouflets)			
177	39	73	C-4	1.0	1.0	1.00	-4.50	-4.50	-0.08§	4.00				Crater not dug out			
178	39	63	C-4	1.0	1.0	1.00	-5.50	-5.50	-0.12§	5.00				Crater not dug out			
179	39	64	C-4	1.0	1.0	1.00	-6.50	-6.50	-0.03§	3.00							

** Stemmed. ‡ 2/3 stemmed. ‡‡ 1/3 water stemmed. § Above original ground surface.

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
Shots Fired in Clay (Continued)																	
Moist clay (Continued)																	
180	39	74	C-4	0.5	0.5	0.79	-5.56	-7.00	-0.01§	3.50				See Table 2	(Camouflets)		
181	39	65	C-4	1.0	1.0	1.00	-7.00	-7.00	-0.03§	3.00				See Table 2	(Camouflets)		
182	39	66	C-4	1.0	1.0	1.00	-7.50	-7.50	-0.01§	2.50							
183	39	75	C-4	0.5	0.5	0.79	-6.35	-8.00									
184	39	67	C-4	1.0	1.0	1.00	-8.00	-8.00	-0.01§	2.50							
185	39	76	C-4	0.5	0.5	0.79	-7.14	-9.00									
186	39	78	C-4	0.5	0.5	0.79	-7.94	-10.00	-0.01§	2.50							
187	39	79	C-4	0.5	0.5	0.79	-8.33	-10.50									
188	39	80	C-4	0.5	0.5	0.79	-8.73	-11.00						Crater not dug out			
189	39	77	C-4	0.5	0.5	0.79	-9.13	-11.50	0.00					See Table 2	(Camouflets)		
190	39	81	C-4	0.5	0.5	0.79	-9.52	-12.00	0.00					See Table 2	(Camouflets)		
Dry clay																	
191	15	301	TNT	320	320	6.84	+3.50	+0.51	1.00	2.50		34		1.00	2.50	34	
192	54	111	TNT	256	256	6.35	+1.65	+0.26									740
193	32	104	TNT	256	256	6.35	+0.83	+0.13	1.47	5.40	0.25	24	60.2				820
194	32	107	TNT	256	256	6.35	0.00	0.00	3.90	6.60	1.15	42	232.1				1,990
195	15	302	TNT	320	320	6.84	0.00	0.00	4.00	7.25		28	240	5.80	9.75	40	800
196	32	103	TNT	256	256	6.35	-0.83	-0.13	Partial detonation								
197	15	303	TNT	320	320	6.84	-1.30	-0.19	5.50	9.00		32	600	7.00	13.50	54	2,300
198	15	308	TNT	2,560	2,560	13.68	-2.60	-0.19	12.00	20.00		31	5,400	13.50	24.50	44	10,000
199	32	106	TNT	256	256	6.35	-1.65	-0.26	6.20	9.10	0.70	31	538.2				3,530
200	32	102	TNT	256	256	6.35	-3.18	-0.50	6.40	10.25	0.65	40	810.4				3,120
201	32	102A	TNT	256	256	6.35	-3.18	-0.50	5.35	9.60	0.95	37	588.2				4,570
202	15	316	TNT	110	110	4.79	-2.45	-0.51	6.00	9.00		38	740				
203	15	304	TNT	320	320	6.84	-3.50	-0.51	6.00	10.50		39	820	10.00	13.75	60	3,100
204	15	310	TNT	320	320	6.84	-3.50	-0.51	7.00	11.00		38	900	10.00	14.50	53	2,900

§ Above original ground surface

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
					Shots Fired in Clay (Continued)												
Dry clay (Continued)																	
205	15	313	TNT	320	320	6.84	-3.50	-0.51	8.00	12.75		36	1,500	9.50	15.25	41	3,000
206	15	309	TNT	2,560	2,560	13.68	-7.00	-0.51	15.50	21.50		34	7,300	17.50	29.50	42	19,000
207	15	312	TNT	2,560	2,560	13.68	-7.00	-0.51	15.00	26.00		31	13,000	18.00	30.50	46	25,000
208	15	317	TNT	2,560	2,560	13.68	-7.00	-0.51	15.50	23.00		34	11,000	17.00	27.50		16,000
209	15	319	TNT	2,560	2,560	13.68	-7.00	-0.51	13.50	23.00		34	7,800	17.00	25.00	68	15,000
210	15	315	TNT	40,000	40,000	34.20	-17.5	-0.51	42.00	64.00		32	190,000	47.00	78.00		350,000
211	15	318	TNT	320,000	320,000	68.40	-35.00	-0.51	60.00	120.00		44	1,100,000	77.00	130.00	46	1,800,000
212	15	311	TNT	8	8	2	-2.00	-1.00	2.50	4.00		47	66	5.00	5.50	72	250
213	32	101	TNT	256	256	6.35	-6.35	-1.00	5.40	10.55	1.25	37	742.4				4,230
214	32	105	TNT	256	256	6.35	-6.35	-1.00	5.80	10.80	1.60	37	856.7				8,380
215	15	305	TNT	320	320	6.84	-7.00	-1.02	7.00	11.75		58	1,300	11.50	16.50	51	4,600
216	15	Symmetry	TNT	320	320	6.84	-7.00	-1.02	7.00	12.50		41	1,300	10.50	15.00	55	3,500
217	15	314	TNT	8	8	2	-2.50	-1.25	3.00	3.0		41	86	4.70	6.50		230
218	15	306	TNT	320	320	6.84	-14.00	-2.05	1.00	15.00		19	236	18.00	20.00	54	9,300
219	15	307	TNT	320	320	6.84	-21.00	-3.07	1.00	10.00		20	100	26.50	15.50	55	5,400
Indefinite clay§§																	
220	35		Pentolite	1.0	1.22	1.07	+0.37	+0.35	0.58	0.67		48					
221	35		Pentolite	1.0	1.22	1.07	+0.25	+0.23	0.79	0.83		51	Average data from two shots				
222	35		Pentolite	1.0	1.22	1.07	+0.12	+0.12	1.17	1.33		48	Average data from four shots				
223	35		Pentolite	1.0	1.22	1.07	0.00	0.00	1.33	1.74		44	Average data from three shots				
224	35		Pentolite	1.0	1.22	1.07	-0.12	-0.12	1.67	2.10		45	Average data from three shots				
225	35		Pentolite	1.0	1.22	1.07	-0.25	-0.23	2.37	2.40		52					
226	35		Pentolite	1.0	1.22	1.07	-0.38	-0.36	2.25	2.23		53	Average data from two shots				
						Shots Fired in Sand											
Wet sand																	
227	15	101	TNT	320	320	6.84	+3.50	+0.51	0.50	4.00		14		0.50	4.00		

§§ Moisture content and temperature of the clay varied over a wide range.

Table 1 (Continued)

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired in Sand (Continued)												
Wet sand (Continued)																	
228	6	1A26	Pentolite	0.96	1.18	1.06	+0.41	+0.39	0.21	1.[illegible]3		15					
229	6	1A27	Pentolite	0.96	1.18	1.06	+0.41	+0.39	0.11	[illegible].35		13					
230	6	1A25	Pentolite	1.05	1.29	1.09	+0.42	+0.39	0.44	1.24		24					
231	32	207	TNT	256	256	6.35	+0.83	+0.13	1.40	4.05	0.50	36	37.4				450
232	32	308	TNT	256	256	6.35	+0.80	+0.13	4.[illegible]0	8.90		47	447.2				
233	6	5A41	Pentolite	5.28	6.47	1.67	+0.23	+0.12	0.66	1.84		25					
234	53	1 ton	C-2 and Tetrytal	∫∫	2,000	12.60	+0.75	+0.06		27.50							
235	53	5 ton	C-2 and Tetrytal	∫∫	10,000	21.50	+1.30	+0.06		32.00							
236	53	10 ton	C-2 and Tetrytal	∫∫	20,000	27.10	+1.63	+0.06		37.50							
237	53	15 ton	C-2 and Tetrytal	∫∫	30,000	31.10	+1.87	+0.06		45.50							
238	53	20 ton	C-2 and Tetrytal	∫∫	40,000	34.20	+2.05	+0.06		50.00							
239	6	1A16	Pentolite	1.05	1.29	1.09	0.00	0.00	0.52	2.07		20					
240	41	31	C-4	27	27	3.00	0.00	0.00	2.40	4.40	0.53	30	54.3				
241	41	32	C-4	27	27	3.00	0.00	0.00	2.20	4.00	0.60	30	46.7				
242	32	206	TNT	256	256	6.35	0.00	0.00	1.70	6.35	0.80	37	129.3				575
243	32	307	TNT	256	256	6.35	0.00	0.00	4.70	12.90		47	1,317.2				
244	15	102	TNT	320	320	6.84	0.00	0.00	2.50	7.62	1.00	23	250	3.25	10.75		520
245	6	1A17	Pentolite	0.96	1.18	1.06	-0.12	-0.11	0.71	1.92		25					
246	6	1A18	Pentolite	0.96	1.18	1.06	-0.12	-0.11	0.69	1.90		24					
247	6	1A19	Pentolite	1.05	1.29	1.09	-0.12	-0.11	0.78	1.99		25					
248	6	5A42	Pentolite	5.34	6.54	1.87	-0.23	-0.12	1.36	3.12		27					
249	32	205	TNT	256	256	6.35	-0.83	-0.13	2.05	9.05	0.60	38	299.8				720
250	32	306	TNT	256	256	6.35	-0.80	-0.13	3.80	13.10		58	1,375.3				
251	32	403	TNT	256	256	6.35	-0.83	-0.13	3.40	8.30	1.00	33	293.3				
252	15	103	TNT	320	320	6.84	-1.30	-0.19	6.00	10.87	1.00	32	720	7.00	13.25		1,400
253	15	108	TNT	2,560	2,560	13.68	-2.60	-0.19	9.75	19.00		30	5,200	10.50	27.00		11,000

∫∫ Only TNT equivalent weight given.

Table 1 (Continued)

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Sand (Continued)														
Wet sand (Continued)																	
254	32	303	TNT	256	256	6.35	-1.60	-0.25	Partial detonation					Data not reported			
255	32	305	TNT	256	256	6.35	-1.60	-0.25	6.30	16.10		48	2,070				
256	32	204	TNT	256	256	6.35	-1.65	-0.26	2.60	9.45	0.40	40	363.6				940
257	32	405	TNT	256	256	6.35	-1.65	-0.26	4.55	9.20	0.80	35	498.2	4.60	9.30	37	626
258	6	1A20	Pentolite	1.04	1.27	1.08	-0.49	-0.45	1.16	2.33		30					
259	6	1A22	Pentolite	1.05	1.29	1.09	-0.50	-0.46	1.22	2.44		30					
260	6	1A21	Pentolite	1.06	1.30	1.09	-0.50	-0.46	1.20	2.54		29					
261	32	203	TNT	256	256	6.35	-3.18	-0.50	3.95	8.35	0.95	43	355.6				920
262	32	301	TNT	256	256	6.35	-3.17	-0.50	Sand and water rapidly filled crater								
263	32	302	TNT	256	256	6.35	-3.17	-0.50	6.20	20.00	0.80	39	3,387.4				
264	32	309	TNT	256	256	6.35	-3.15	-0.50	6.10	16.70		40	2,718.4				
265	32	310	TNT	256	256	6.35	-3.15	-0.50	5.20	17.50		46	2,598.0				
266	32	401	TNT	256	256	6.35	-3.18	-0.50	5.50	10.60	0.60	26	824.4	6.30	11.30	38	1,182
267	32	406	TNT	256	256	6.35	-3.17	-0.50	4.00	9.85	1.25	45	672.7				
268	15	104	TNT	320	320	6.84	-3.50	-0.51	6.50	12.00		32	1,300	7.50	15.50	30	2,600
269	15	110	TNT	320	320	6.84	-3.50	-0.51	7.50	13.00		33	1,600	8.75	16.80	32	2,800
270	15	113	TNT	320	320	6.84	-3.50	-0.51	6.75	14.00		29	1,900	7.50	17.50	27	3,800
271	15	109	TNT	2,560	2,560	13.68	-7.00	-0.51	8.50	24.75		23	8,200	13.50	29.75	28	14,000
272	15	112	TNT	2,560	2,560	13.68	-7.00	-0.51	12.50	30.00		26	13,000	17.50	34.00	31	25,000
273	15	115	TNT	40,000	40,000	34.20	-17.50	-0.51	23.00	75.00		22	180,000	30.00	82.50	24	300,000
274	32	305A	Dynamite	290	171.8	5.56	-3.17	-0.57	Data not reported								
275	32	304**	TNT	256	256	6.35	-4.77	-0.75	6.60	19.50		44					
276	32	402	TNT	256	256	6.35	-4.77	-0.75	6.20	11.05	1.45	35	942.7	8.20	12.50	39	1,687
277	6	1A24	Pentolite	1.05	1.29	1.09	-1.01	-0.93	1.81	3.02		34					
278	6	1A23	Pentolite	0.96	1.18	1.06	-1.00	-0.94	1.76	2.89		35					
279	32	201	TNT	256	256	6.35	-6.35	-1.00	Partial detonation				Data not reported				

** Detonated in shot number 303 crater (item 305).

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Sand (Continued)														
Wet sand (Continued)																	
280	32	202	TNT	256	256	6.35	-6.35	-1.00	5.50	11.30	1.05	40	1,044.8				2,630
281	32	212	TNT	256	256	6.35	-6.35	-1.00	5.85	11.70	1.60	43	1,206.9				4,290
282	32	404	TNT	256	256	6.35	-6.35	-1.00	6.00	11.75	1.95	42	1,190.5	8.40	14.20	43	2,358
283	15	105	TNT	320	320	6.84	-7.00	-1.02	8.50	15.50		32	2,600	12.50	18.50	37	4,400
284	15	111	TNT	8	8	2	-2.50	-1.25	4.00	6.00		37	140	5.50	6.50	43	260
285	15	114	TNT	8	8	2	-2.50	-1.25	3.50	6.00		33	150	6.50	7.50	44	510
286	15	116	TNT	320	320	6.84	-8.75	-1.28	9.00	18.50		32	3,500				
287	15	106	TNT	320	320	6.84	-14.00	-2.05	4.50	16.75		20	1,100	17.00	19.50	45	6,200
288	15	107	TNT	320	320	6.84	-21.00	-3.07	3.50	13.50		20	790	23.00	17.00	15	7,300
Dry-to-moist sand																	
289	6	5C2	Pentolite	5.28	6.47	1.87	+1.29	+0.69	0.17	1.93	0.10		0.74				
290	6	5C1	Pentolite	5.29	6.48	1.87	+1.29	+0.69	0.17	1.97	0.10		0.85				
291	6	1C7	Pentolite	1.10	1.35	1.10	+0.75	+0.68	0.18	1.22	0.05		0.23				
292	6	1C8	Pentolite	1.07	1.31	1.10	+0.74	+0.67	0.12	1.50	0.05		0.37				
293	6	1/2 C2	Pentolite	0.55	0.67	0.83	+0.45	+0.51	0.72	1.40	0.11	24	1.42				
294	6	1C19	Pentolite	0.96	1.18	1.06	+0.50	+0.47	0.07	1.11	0.05		0.15				
295	6	5C3	Pentolite	5.25	6.43	1.86	+0.87	+0.47	0.17	1.84	0.21		1.84				
296	6	5C4	Pentolite	5.27	6.46	1.86	+0.87	+0.47	0.17	1.94	0.23		0.74				
297	6	1/2 C7	Pentolite	0.55	0.67	0.88	+0.40	+0.45	0.26	1.31		17	0.30				
298	6	1C10	Pentolite	1.09	1.34	1.10	+0.50	+0.45	0.12	1.07	0.05		0.17				
299	6	1C9	Pentolite	1.10	1.35	1.10	+0.49	+0.45	0.08	1.35	0.05		0.24				
300	6	1/4 C7	Pentolite	0.26	0.32	0.68	+0.30	+0.44	0.19	1.00		17	0.20				
301	6	1/4 C1	Pentolite	0.27	0.33	0.69	+0.30	+0.43	0.12	0.99			0.14				
302	40	689	TNT	4.0	4.0	1.59	+0.60	+0.40	0.20	1.83	0.02	14					
303	40	690	TNT	4.0	4.0	1.59	+0.60	+0.40	0.19	1.83	0.02	13					
304	40	691	TNT	4.0	4.0	1.59	+0.50	+0.30	0.26	1.75	0.04	15					

Table 1 (Continued) (13 of 24 sheets)

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Sand (Continued)														
Dry-to-moist sand (Continued)																	
305	40	692	TNT	4.0	4.0	1.59	+0.50	+0.30	0.22	1.72	0.05	14					
306	6	1011	Pentolite	1.10	1.35	1.10	+0.25	+0.23	0.18	1.19	0.11		0.34				
307	6	1012	Pentolite	1.10	1.35	1.10	+0.25	+0.23	0.25	1.05	0.15		0.38				
308	40	693	TNT	4.0	4.0	1.59	+0.30	+0.20	0.33	1.73	0.08	17					
309	40	694	TNT	4.0	4.0	1.59	+0.30	+0.20	0.32	1.87	0.07	16					
310	7	HE-4	TNT	2,560	2,560	13.68	+2.01	+0.15	1.90	6.10	2.80	23	110	2.10	8.00	4	180
311	40	695	TNT	4.0	4.0	1.59	+0.20	+0.10	0.49	2.17	0.08	19					
312	40	696	TNT	4.0	4.0	1.59	+0.20	+0.10	0.57	2.14	0.10	20					
313	6	1/4 C2	Pentolite	0.26	0.32	0.68	0.00	0.00	0.63	1.34	0.10	25	1.27				
314	6	1024	Pentolite	0.96	1.18	1.06	0.00	0.00	0.61	1.67	0.12	23	2.15				
315	6	1015	Pentolite	0.97	1.19	1.06	0.00	0.00	0.76	1.76	0.20	27	3.44				
316	6	1014	Pentolite	0.98	1.20	1.06	0.00	0.00	0.68	1.68	0.16	28	3.31				
317	6	1013	Pentolite	1.10	1.35	1.10	0.00	0.00	0.49	1.60	0.16	25	2.28				
318	40	697	TNT	4.0	4.0	1.59	0.00	0.00	0.87	2.64	0.08	23					
319	40	698	TNT	4.0	4.0	1.59	0.00	0.00	0.81	2.53	0.15	22					
320	6c	505	Pentolite	5.07	6.21	1.84	0.00	0.00	0.95	3.03		32	9.89				
321	41	1	C-4 (12.55)#	27	27	3.00	0.00	0.00	1.95	4.25	0.42	28	54.3	1.95	4.50	27	60.7
322	41	2	C-4 (12.55)#	27	27	3.00	0.00	0.00	2.16	4.50	0.46	39	68.6	2.25	4.60	40	73.0
323	41	10	C-4 (3.00)#	27	27	3.00	0.00	0.00	2.30	4.50	0.41	30	60.6	2.31	4.50	30	77.8
324	41	11	C-4 (3.00)#	27	27	3.00	0.00	0.00	2.20	4.20	0.52	30	47.9	2.20	4.30	30	52.6
325	41	18	C-4 (1.50)#	27	27	3.00	0.00	0.00	1.40##	4.50	0.53	39	63.9				
326	41	19	C-4 (1.50)#	27	27	3.00	0.00	0.00	1.30##	4.50	0.39	38	59.1				
327	41	3	Dynamite (12.55)#	54	36.8	3.32	0.00	0.00	2.20	5.00	0.46	28	81.8	2.24	5.15	30	89.3
328	41	4	Dynamite (12.55)#	54	36.8	3.32	0.00	0.00	2.10	5.00	0.51	32	72.2	2.16	5.10	31	79.5
329	41	12	Dynamite (3.00)#	54	36.8	3.32	0.00	0.00	2.30	4.65	0.57	34	68.7	2.36	4.67	34	73
330	41	13	Dynamite (3.00)#	54	36.8	3.32	0.00	0.00	2.36	4.87	0.54	32	73.4	2.45	4.87	32	83.7

\# Thickness of overburden (feet). ## Base slab exposed by shot.

Table 1 (Continued)

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired in Sand (Continued)												
Dry-to-moist sand (Continued)																	
331	41	20	Dynamite (1.50)#	54	36.8	3.32	0.00	0.00	1.32	4.90	0.44	34	67.6	0.13¢	2.00¢		1.63¢
332	41	21	Dynamite (1.50)#	54	36.8	3.32	0.00	0.00	1.42	5.20	0.46	48	93.7	0.10¢			
333	41	5	TNT (12.55)#	256	256	6.34	0.00	0.00	3.36	8.55	0.61	33	419	3.65	8.55	33	450
334	41	6	TNT (12.55)#	256	256	6.34	0.00	0.00	3.50	8.60	0.80	31	391	3.55	8.60	31	412
335	41	8	TNT (6.35)#	256	256	6.34	0.00	0.00	4.20	8.70	0.71	27	395				
336	41	9	TNT (6.35)#	256	256	6.34	0.00	0.00	4.40	9.25	0.82	28	539				
337	41	14	TNT (3.13)#	256	256	6.34	0.00	0.00	2.85##	9.00	0.87	35	448				
338	41	15	TNT (3.13)#	256	256	6.34	0.00	0.00	2.90##	9.60	0.94	38	531				
339	40	699	TNT	4.0	4.0	1.59	-0.21	-0.13	1.22	2.96	0.24	26					
340	40	700	TNT	4.0	4.0	1.59	-0.21	-0.13	1.20	3.10	0.24	25					
341	41	16	TNT (3.13)#	256	256	6.34	-0.85	-0.13	3.30	10.50	0.97	40	686	0.57¢	5.50¢	40¢	15¢
342	41	17	TNT (3.13)#	256	256	6.34	-0.85	-0.13	3.42	12.00	0.95	42	1,040	0.52¢	6.50¢	42¢	19¢
343	2	HE-9	TNT	216	216	6.00	-0.84	-0.14	3.50	8.30	0.70	24	270	4.00	14.70	6	1,120
344	2	HE-9(A)	Pentolite	177	216	6.00	-0.84	-0.14	3.40	8.60	1.00	32	290	4.00	15.00	6	1,310
345	7	HE-1	TNT	2,560	2,560	13.68	-2.01	-0.15	6.70	18.50	1.40	40	2,010	7.60	23.00	11	4,270
346	7	HE-2	TNT	40,000	40,000	34.20	-4.63	-0.15	15.00	39.00	3.00	40	37,070				
347	2	HE-8	Pentolite	177	216	6.00	-1.08	-0.18	3.30	8.70	1.00	35	380	4.30	16.40	5	1,310
348	2	HE-7	TNT	2,560	2,560	13.68	-2.50	-0.19	6.70	19.00	2.00	35	3,300	8.60	32.80	4	6,180
349	2	HE-6	TNT	2,560	2,560	13.68	-3.00	-0.22	6.10	19.80	1.60	29	3,600	10.10	34.30	9	8,800
350	6	1C17	Pentolite	0.97	1.19	1.06	-0.25	-0.24	1.00	2.25	0.22	30	7.51				
351	6	1C16	Pentolite	0.98	1.20	1.06	-0.25	-0.24	1.10	2.33	0.30	30	8.81				
352	40	701	TNT	4.0	4.0	1.59	-0.41	-0.26	1.40	3.42	0.26	26					
353	40	702	TNT	4.0	4.0	1.59	-0.41	-0.26	1.39	3.40	0.29	26					
354	2	HE-5	TNT	2,560	2,560	13.68	-4.00	-0.30	7.50	19.40	1.30	24	4,000	9.50	32.60	3	8,700
355	6	1/4 C3	Pentolite	0.26	0.32	0.68	-0.29	-0.43	0.72	1.79	0.12	25	2.76				
356	6	1/2 C3	Pentolite	0.55	0.67	0.88	-0.40	-0.45	1.10	2.09	0.20	28	5.51				

\# Thickness of overburden (feet). ## Base slab exposed by shot. ¢ Crater dimensions of concrete slab.

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired in Sand (Continued)												
Dry-to-moist sand (Continued)																	
357	6	1/2 C14	Pentolite	0.56	0.69	0.88	-0.41	-0.47	1.12	2.26	0.19	30	7.59				
358	6	1C20	Pentolite	0.96	1.18	1.06	-0.50	-0.47	1.20	2.28	0.29	31	8.18				
359	6	1C18	Pentolite	0.97	1.19	1.06	-0.50	-0.47	1.27	2.57	0.20	32	12.04				
360	2	HE-10	TNT	216	216	6.00	-3.00	-0.50	5.50	11.30	0.80	40	860	6.30	18.60	9	2,600
361	2	HE-10(B)	Pentolite	177	216	6.00	-3.00	-0.50	4.10	9.60	1.00	40	520	5.50	16.70	6	1,460
362	7	HE-3	TNT	2,560	2,560	13.68	-6.79	-0.50	10.80	20.50	1.20	34	6,640	11.00	22.00	43	7,580
363	6	1/4 C6	Pentolite	0.26	0.32	0.68	-0.95	-0.72	1.43	2.02	0.28	30	6.43				
364	6	1/2 C4	Pentolite	0.54	0.66	0.87	-0.80	-0.92	1.37	2.44	0.31	32	[illegible]				
365	6	1/4 C4	Pentolite	0.26	0.32	0.68	-0.63	-0.93	1.04	2.00	0.22	31	5.12				
366	6	1/2 C11	Pentolite	0.55	0.67	0.88	-0.82	-0.93	1.85	2.50	0.34	49	10.96				
367	6	1/2 C13	Pentolite	0.55	0.67	0.88	-0.82	-0.93	1.81	2.66	0.20	37	12.67				
368	6	1C21	Pentolite	0.96	1.18	1.06	-1.00	-0.94	1.41	2.87	0.24	35	15.28				
369	6	1/2 C10	Pentolite	0.55	0.67	0.88	-1.23	-1.40	2.19	2.76	0.17	60	15				
370	6	1/2 C12	Pentolite	0.55	0.67	0.88	-1.23	-1.40	1.87	2.71	0.34	38	14.28				
371	6	1C22	Pentolite	0.95	1.16	1.05	-1.49	-1.42	1.51	2.73	0.33	37	14.86				
372	6	1/4 C5	Pentolite	0.26	0.32	0.68	-1.20	-1.76	0.31	1.64	0.23		1.15				
373	6	1/2 C6	Pentolite	0.55	0.67	0.88	-1.59	-1.81	0.66	2.09	0.39		3.84				
374	6	1/2 C8	Pentolite	0.55	0.67	0.88	-1.64	-1.86	1.15	1.69	0.24	37	10.02				
375	6	1/2 C9	Pentolite	0.55	0.67	0.88	-1.64	-1.86	2.17	2.58	0.28	51	14.72				
376	6	1C23	Pentolite	0.96	1.18	1.06	-2.01	-1.90	0.41	2.41	0.30		2.81				
377	6	1/4 C8	Pentolite	0.26	0.32	0.68	-1.93	-2.84	0.50	1.84		20	2.19				
					Shots Fired in Moist Loess												
378	39	34	C-4	0.5	0.5	0.79	0.00	0.00	0.20	0.90	0.08	34	0.34	0.62	0.95	43	0.73
379	39	39	C-4	0.5	0.5	0.79	0.00	0.00	0.28	1.10	0.04	22	0.73	0.75	1.12	25	1.18
380	39	19	C-4	1.0	1.0	1.00	0.00	0.00	0.56	1.20	0.02	15	1.01	0.81	1.20	24	1.10
381	39	35	C-4	1.0	1.0	1.00	0.00	0.00	0.53	1.25	0.10	23	0.36	0.79	1.40	32	1.46

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Moist Loess (Continued)														
382	39	23	C-4	1.0	1.0	1.00	-0.50	-0.50	1.20	2.00	0.27	21	4.17	1.40	2.25	29	6.98
383	39	27	C-4	1.0	1.0	1.00	-0.50	-0.50	0.93	2.00	0.10	20	3.93	1.47	2.00	45	6.41
384	39	42	C-4	0.5	0.5	0.79	-0.50	-0.63	0.60	1.50	0.04	41	2.31	1.21	1.70	37	3.77
385	39	52	C-4	0.5	0.5	0.79	-0.50	-0.63	0.35	2.00	0.07	30	3.41	1.33	2.00	48	6.40
386	39	24	C-4	1.0	1.0	1.00	-1.00	-1.00	0.72	2.20	0.20	50	6.08	2.03	2.75	34	13.8
387	39	26	C-4	1.0	1.0	1.00	-1.00	-1.00	0.65	2.25	0.15	28	5.84	2.07	2.25	45	11.4
388	20	B-13	TNT	64	64	4.00	-4.20	-1.05		8.00							
389	20	B-14	TNT	64	64	4.00	-4.20	-1.05		10.00							
390	20	C-21	TNT	64	64	4.00	-4.20	-1.05		9.50							
391	20	C-22	TNT	64	64	4.00	-4.20	-1.05		8.00							
392	20	C-24	TNT	64	64	4.00	-4.20	-1.05		7.50							
393	20	C-28	TNT	64	64	4.00	-4.20	-1.05		6.24							
394	20	C-30	TNT	64	64	4.00	-4.20	-1.05		8.75							
395	39	35	C-4	0.5	0.5	0.79	-1.00	-1.26	0.31	2.00	0.10	22	2.70	1.73	2.00	27	5.89
396	39	47	C-4	0.5	0.5	0.79	-1.00	-1.26	0.35	1.75	0.11	22	1.54	1.73	1.85	51	6.26
397	39	22	C-4	1.0	1.0	1.00	-1.50	-1.50	0.33	3.20	0.09	17	3.54	2.49	3.00	41	19.6
398	39	28	C-4	1.0	1.0	1.00	-1.50	-1.50	0.58	2.25	0.15	42	5.50	2.52	2.50	47	17.1
399	20	B-15	TNT	64	64	4.00	-6.30	-1.58		9.75							
400	20	B-16	TNT	64	64	4.00	-6.30	-1.58		8.92							
401	39	50	C-4	0.5	0.5	0.79	-1.50	-1.89	-0.02§	3.00				2.28	2.00	45	8.63
402	39	54	C-4	0.5	0.5	0.79	-1.50	-1.89	0.70	1.50	0.09	40	2.38	2.23	1.50	66	6.81
403	39	18	C-4	1.0	1.0	1.00	-2.00	-2.00	0.20	2.25	0.16	37	2.85	2.99	2.50	61	19.8
404	39	21	C-4	1.0	1.0	1.00	-2.00	-2.00	0.13	2.60	0.11	12	2.22	3.02	2.75	46	20.3
405	20	A-7	TNT	64	64	4.00	-8.40	-2.10		7.50							
406	20	B-12	TNT	64	64	4.00	-8.40	-2.10		9.50							
407	39	16	C-4	1.0	1.0	1.00	-2.50	-2.50	0.19	2.00	0.15	16	1.97	3.62	2.50	36	20.6
408	39	17	C-4	1.0	1.0	1.00	-2.50	-2.50	0.40	1.35	0.15	28	1.12	3.52	3.00	41	25.7

§ Above original ground surface.

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Moist Loess (Continued)														
409	39	36	C-4	0.5	0.5	0.79	-2.00	-2.52	-0.30§	2.50		20	3.11	2.78	1.75		11.1
410	39	40	C-4	0.5	0.5	0.79	-2.00	-2.52	-0.07§	3.25		3		2.76	1.75	62	8.36
411	39	53	C-4	0.5	0.5	0.79	-2.00	-2.52	-0.12§	3.00		8		2.74	1.50	54	7.4
412	39	44	C-4	0.5	0.5	0.79	-2.18	-2.74	-0.67§	3.00		29		See Table 2		(Camouflets)	
413	39	48	C-4	0.5	0.5	0.79	-2.18	-2.74	0.07	3.00		30		2.96	1.50	82	8.81
414	39	51	C-4	0.5	0.5	0.79	-2.18	-2.74	0.02	2.75				2.99	1.50	67	8.03
415	39	29ϕϕ	C-4	1.0	1.0	1.00	-2.75	-2.75	-0.04§	5.00				3.79	3.00	33	28.5
416	39	31ϕϕ	C-4	1.0	1.0	1.00	-2.75	-2.75	-0.31§	5.00		11		3.85	2.50	37	18.0
417	39	33	C-4	1.0	1.0	1.00	-2.75	-2.75	-0.31§	4.50		13		3.75	2.50		21.0
418	39	12ϕϕ	C-4	1.0	1.0	1.00	-3.00	-3.00	-0.55§	4.00		21		4.06	2.50	65	22.3
419	39	15ϕϕ	C-4	1.0	1.0	1.00	-3.00	-3.00	-0.70§	5.00		22		4.10	2.75	48	25.6
420	39	43	C-4	0.5	0.5	0.79	-2.50	-3.15	-0.28§	3.25		16		See Table 2		(Camouflets)	
421	39	49	C-4	0.5	0.5	0.79	-2.50	-3.15	-0.51§	3.00		25		See Table 2		(Camouflets)	
422	39	30	C-4	1.0	1.0	1.00	-3.25	-3.25	-0.48§	4.50		18		See Table 2		(Camouflets)	
423	39	32	C-4	1.0	1.0	1.00	-3.25	-3.25	-0.55§	4.50		20		See Table 2		(Camouflets)	
424	39	9	C-4	1.0	1.0	1.00	-3.50	-3.50	-0.84§	4.00		28		See Table 2		(Camouflets)	
425	39	10	C-4	1.0	1.0	1.00	-3.75	-3.75	-0.63§	4.00		24		See Table 2		(Camouflets)	
426	39	14	C-4	1.0	1.0	1.00	-3.75	-3.75	-0.45§	5.00		16		See Table 2		(Camouflets)	
427	39	37	C-4	0.5	0.5	0.79	-3.00	-3.78	-0.36§	3.00		20		See Table 2		(Camouflets)	
428	39	55	C-4	0.5	0.5	0.79	-3.00	-3.78	-0.26§	3.00		16		See Table 2		(Camouflets)	
429	39	41	C-4	0.5	0.5	0.79	-3.10	-3.90	-0.26§	2.75		16		See Table 2		(Camouflets)	
430	39	45	C-4	0.5	0.5	0.79	-3.10	-3.90	-0.17§	3.25		9		See Table 2		(Camouflets)	
431	39	11	C-4	1.0	1.0	1.00	-4.00	-4.00	-0.30§	4.00		12		See Table 2		(Camouflets)	
432	39	13	C-4	1.0	1.0	1.00	-4.00	-4.00	-0.31§	4.50		12		See Table 2		(Camouflets)	
433	39	20	C-4	1.0	1.0	1.00	-4.00	-4.00	-0.31§	2.25		22		See Table 2		(Camouflets)	
434	39	38	C-4	0.5	0.5	0.79	-3.25	-4.10	-0.30§	3.00		17		See Table 2		(Camouflets)	
435	39	46	C-4	0.5	0.5	0.79	-3.25	-4.10	-0.27§	3.00		16		See Table 2		(Camouflets)	

§ Above original ground surface. ϕϕ Partial camouflet.

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Moist Loess (Continued)														
436	39	84	C-4	0.125	0.125	0.50	-2.50	-5.00						See Table 2		(Camouflets)	
437	39	85	C-4	0.125	0.125	0.50	-2.50	-5.00						See Table 2		(Camouflets)	
438	39	82	C-4	8.0	8.0	2.00	-10.00	-5.00						See Table 2		(Camouflets)	
439	39	83	C-4	8.0	8.0	2.00	-10.00	-5.00						See Table 2		(Camouflets)	
440	39	1	C-4	1.0	1.0	1.00	-6.00	-6.00	-0.02§	3.00				See Table 2		(Camouflets)	
441	39	2	C-4	1.0	1.0	1.00	-6.00	-6.00	-0.05§	4.00		1		See Table 2		(Camouflets)	
442	39	7	C-4	1.0	1.0	1.00	-6.00	-6.00	-0.04§	4.00		1		See Table 2		(Camouflets)	
443	39	3	C-4	1.0	1.0	1.00	-8.00	-8.00	-0.01§	4.50				See Table 2		(Camouflets)	
444	39	4	C-4	1.0	1.0	1.00	-8.00	-8.00	-0.02§	4.00				See Table 2		(Camouflets)	
445	39	5	C-4	1.0	1.0	1.00	-10.00	-10.00	-0.01§	3.50				See Table 2		(Camouflets)	
446	39	6	C-4	1.0	1.0	1.00	-10.00	-10.00						See Table 2		(Camouflets)	
447	39	8	C-4	1.0	1.0	1.00	-14.00	-14.00	0.00					See Table 2		(Camouflets)	
			Shots Fired in Wet Silt														
448	44	E1-51	C-4	27	27	3.00	+1.85	+0.62	0.40	3.00		5	4.17				
449	44	E1-52	C-4	27	27	3.00	+1.85	+0.62	0.27	2.85		5	2.46				
450	44	E1-53	C-4	27	27	3.00	+1.85	+0.62	0.30	3.50		5	5.08				
451	44	E1-48	Dynamite†	54	36.8	3.32	-1.50	-0.45	3.60	7.20	0.80	36	280	5.00	7.50	54	361
452	44	E1-49	Dynamite**	54	36.8	3.32	-1.50	-0.45	4.50	8.00	1.00	37	452	5.20	8.50	29	548
453	44	E1-50	Dynamite**	54	36.8	3.32	-1.50	-0.45	5.30	8.30	1.05	37	504	5.30	9.00	29	634
454	44	E1-58	Dynamite†	54	36.8	3.32	-1.50	-0.45	3.70	6.35	0.62	36	177	4.70	7.00	54	362
455	44	E1-59	Dynamite†	54	36.8	3.32	-1.50	-0.45	3.60	6.75	0.50	36	223	4.80	7.50	54	422
456	44	E1-54	C-4**	27	27	3.00	-1.50	-0.50	4.20	7.50	1.00	33	362	4.80	8.50	31	528
457	44	E1-55	C-4†	27	27	3.00	-1.50	-0.50	3.68	6.50	0.80	41	220	5.00	7.00	33	336
458	44	E1-56	C-4†	27	27	3.00	-1.50	-0.50	4.00	7.00	0.68	41	264	5.18	8.00	33	404
459	44	E1-57	C-4**	27	27	3.00	-1.50	-0.50	5.30	8.25	0.75	33	437	5.50	9.00	31	568

** Stemmed. † Unstemmed. § Above original ground surface.

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired with Shaped Charges												
Clay																	
460	1	19	TNT[B]	128(53.8)†	128	5.04	+1.80	+0.36	2.90	2.88		53					
461	1	20	TNT[B]	128(53.8)†	128	5.04	+1.80	+0.36	3.10	3.50		49					
462	1	21	TNT[B]	128(53.8)†	128	5.04	+1.80	+0.36	2.10	3.75		37					
463	1	22	TNT[B]	128(53.8)†	128	5.04	+1.80	+0.36	3.10	3.50		49					
464	1	27	Amatol[B]	242(50)†	242††	6.23	+2.23	+0.36	3.50	6.35		36					
465	1	28	Amatol[B]	242(50)†	242††	6.23	+2.23	+0.36	5.00	7.50		41					
466	1	29	Amatol[B]	242(50)†	242††	6.23	+2.23	+0.36	4.50	6.75		41					
467	1	30	Amatol[B]	242(50)†	242††	6.23	+2.23	+0.36	2.66	6.75		31					
468	1	31	Amatol[B]	242(50)†	242††	6.23	+2.23	+0.36	2.66	6.75		31					
469	1	32	TNT[B]	1,496(75)†	1,496	11.44	+3.90	+0.34	4.50	6.37		42					
470	1	33	TNT[B]	1,496(75)†	1,496	11.44	+3.90	+0.34	3.75	5.50		41					
471	1	34	TNT[B]	1,496(75)†	1,496	11.44	+3.90	+0.34	4.10	6.00		41					
472	1	35	Amatol[B]	1,496(75)†	1,496††	11.44	+3.75	+0.33	3.66	5.00		43					
473	1	36	Amatol[B]	1,496(75)†	1,496††	11.44	+3.25	+0.28	4.00	6.25		40					
474	1	37	Amatol[B]	2,790(70)†	2,790††	14.08	+3.40	+0.24	7.33	11.75		39					
475	1	44	PAG	300			+1.50		4.31	6.66		40					
476	1	45	PAG	300			+1.50		4.17	7.50		37					
477	1	7	TNT[G]	51.8(47)†	51.8	3.73	-1.00	-0.27	4.75	8.25		38					
478	1	6	TNT[G]	51.8(47)†	51.8	3.73	-2.50	-0.67	5.66	9.25		39					
479	1	11	TNT[G]	275.6(50)†	275.6	6.51	-8.00	-1.23	9.00	16.88		36					
480	1	9	TNT[G]	275.6(50)†	275.6	6.51	-9.50	-1.46	9.00	17.50		35					
481	1	18	Amatol[B]	85.44(48)†	85.44††	4.40	-7.50	-1.70	4.75	9.62		35					
482	1	24	TNT[B]	128(53.8)†	128	5.04	-9.50	-1.88	8.00	15.00		36					
483	1	8	Amatol[G]	275.6(50)†	275.6††	6.51	-12.50	-1.92	8.50	18.25		33					
484	1	10	TNT[G]	275.6(50)†	275.6	6.51	-12.50	-1.92	9.00	18.75		34					
485	1	12	TNT[G]	275.6(50)†	275.6	6.51	-12.50	-1.92	10.00	17.50		37					

Note: [B] indicates British Bomb; [G] indicates German Bomb. † Per cent of charge weight to total bomb weight. †† Amatol and TNT are considered equal.

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired with Shaped Charges (Continued)												
Clay (Continued)																	
486	1	13	TNT[G]	275.6(50)✝	275.6	6.51	-12.50	-1.92	11.00	18.25		38					
487	1	14	TNT[G]	275.6(50)✝	275.6	6.51	-12.50	-1.92	16.00	18.00		38					
488	1	2	TNT[G]	51.8(47)✝	51.8	3.73	-7.20	-1.93	5.45	10.50		35					
489	1	3	TNT[G]	51.8(47)✝	51.8	3.73	-7.20	-1.93	7.33	10.50		42					
490	1	26	TNT[B]	128(53.8)✝	128	5.04	-10.00	-1.94	6.00	14.00		32					
491	1	17	TNT[G]	1,102.3(50)✝	1,102.3	10.33	-20.00	-1.94	14.00	28.50		34					
492	1	42	PAG	133			-10.00		7.00	14.75		34					
493	1	41	PAG	67			-8.00		6.00	12.00		36					
494	1	23	TNT[B]	128(53.8)✝	128	5.04	-10.00	-1.98	6.00	14.00		32					
495	1	25	TNT[B]	128(53.8)✝	128	5.04	-10.00	-1.98	8.00	15.00		36					
496	1	38	PAG	0.125			-1.00		0.75	1.50		35					
497	1	16	TNT[G]	485(44)✝	485	7.86	-16.00	-2.04	9.00	21.00		32					
498	1	1	TNT[G]	35.3(32)✝	35.3	3.28	-7.00	-2.13	2.75	8.00		29					
499	1	40	PAG	33			-7.00		4.70	9.00		35					
500	1	39	PAG	1.0			-2.25		1.50	3.00		35					
501	1	5	TNT[G]	51.8(47)✝	51.8	3.73	-8.50	-2.28	4.33	10.25		32					
502	1	43	PAG	166			-13.00		9.00	15.00		38					
503	1	15	TNT[G]	275.6(50)✝	275.6	6.51	-22.00	-3.38	6.20	13.50		33					
504	1	4	TNT[G]	51.8(47)✝	51.8	3.73	-16.00	-4.29	-1.66§	4.75		29					
Dry clay																	
505	17	1	TNT	1.0	1.0	1.00	0.00	0.00	0.69	0.96							
506	17	5	TNT	1.0	1.0	1.00	-1.00	-1.00	0.46	2.41				2.00	2.41		
507	17	10	TNT	1.0	1.0	1.00	-1.00	-1.00	0.58	2.08				2.17	2.12		
508	17	13	TNT	1.0	1.0	1.00	-1.00	-1.00	0.83	2.12				2.33	2.12		
509	17	3	TNT	1.0	1.0	1.00	-1.50	-1.50	0.50	2.50				2.25	2.50		
510	17	8	TNT	1.0	1.0	1.00	-1.50	-1.50	0.50	2.50				2.50	2.62		

Note: [B] indicates British Bomb; [G] indicates German Bomb. § Above original ground surface. ✝ Per cent of charge weight to total bomb weight.

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired with Shaped Charges (Continued)												
Dry clay (Continued)																	
511	17	15	TNT	8.0	8.0	2.00	-3.00	-1.50	2.00	6.00				3.67	5.50		
512	17	7	TNT	1.0	1.0	1.00	-1.60	-1.60	0.67	2.58				2.75	2.58		
513	17	6	TNT	1.0	1.0	1.00	-2.00	-2.00	0.50	2.50				3.00	2.75		
514	17	14	TNT	1.0	1.0	1.00	-2.00	-2.00	0.33	2.62				3.58	2.75		
515	17	2	TNT	1.0	1.0	1.00	-2.50	-2.50	0.25	2.50							
516	17	4	TNT	1.0	1.0	1.00	-2.50	-2.50	0.83	1.50				4.50	2.25		
517	17	12	TNT	1.0	1.0	1.00	-2.50	-2.50	0.17	1.75				3.33	1.62		
518	17	9	TNT	1.0	1.0	1.00	-3.50	-3.50						4.00	1.62		
519	17	11	TNT	1.0	1.0	1.00	-3.50	-3.50						4.50	1.50		
Undisturbed, dry, hard Sassafras clay loam																	
520	37	A-1	TNT	1.0	1.0	1.00	0.00	0.00						0.67	0.92		
521	37	B-1	TNT	1.0	1.0	1.00	0.00	0.00						0.50	1.16		
522	37	C-1	TNT	1.0	1.0	1.00	0.00	0.00						0.50	1.00		
523	37	A-2	TNT	1.0	1.0	1.00	-2.00	-2.00						3.00	2.83		
524	37	B-2	TNT	1.0	1.0	1.00	-2.00	-2.00						3.17	3.25		
525	37	C-2	TNT	1.0	1.0	1.00	-2.00	-2.00						3.33	3.00		
526	37	A-3	TNT	1.0	1.0	1.00	-3.50	-3.50						4.50	2.71		
527	37	B-3	TNT	1.0	1.0	1.00	-3.50	-3.50						4.75	2.75		
528	37	C-3	TNT	1.0	1.0	1.00	-3.50	-3.50						4.50	2.87		
Sandy clayey silt																	
529	5	A-3	TNT	8.0	8.0	2.00	-4.20	-2.10		4.30							
530	5	A-8	TNT	8.0	8.0	2.00	-4.20	-2.10		4.80							
531	5	A-9	TNT	8.0	8.0	2.00	-4.20	-2.10		4.70							
532	5	A-13	TNT	216	216	6.00	-12.60	-2.10		13.50							
533	5	A-24	TNT	1,000	1,000	10.00	-21.00	-2.10	6.20	18.25	1.20	30	2,300				
534	5	A-25	TNT	1,000	1,000	10.00	-21.00	-2.10	4.30	20.75	1.10	19	3,400				

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired with Shaped Charges (Continued)												
Sandy clayey silt (Continued)																	
535	5	B-11	TNT	64	64	4.00	-8.40	-2.10		10.75							
536	5	B-13	TNT	64	64	4.00	-8.40	-2.10		9.25							
537	5	B-14	TNT	64	64	4.00	-8.40	-2.10		9.65							
538	5	B-15	TNT	64	64	4.00	-8.40	-2.10		9.75							
539	5	B-25	TNT	216	216	6.00	-12.60	-2.10		10.75							
540	5	B-26	TNT	1,000	1,000	10.00	-21.00	-2.10	9.30	18.00	1.80	16	2,590				
541	5	B-32	TNT	1,080	1,080	10.25	-21.00	-2.10		20.50							
542	5	B-33	TNT	64	64	4.00	-8.40	-2.10		8.25							
543	5	B-34	TNT	64	64	4.00	-8.40	-2.10		6.50							
544	5	B-35	TNT	64	64	4.00	-8.40	-2.10		7.50							
545	5	B-36	TNT	8.0	8.0	2.00	-4.20	-2.10		4.00							
546	5	B-37	TNT	8.0	8.0	2.00	-4.20	-2.10		5.35							
547	5	B-38	TNT	8.0	8.0	2.00	-4.20	-2.10		5.25							
548	5	B-39	TNT	8.0	8.0	2.00	-4.20	-2.10		4.25							
549	5	B-40	TNT	8.0	8.0	2.00	-4.20	-2.10		5.50							
550	5	B-41	TNT	8.0	8.0	2.00	-4.20	-2.10		4.50							
Silty sandy clay																	
551	5	A-5	TNT	8.0	8.0	2.00	-4.20	-2.10		4.25							
552	5	A-6	TNT	8.0	8.0	2.00	-4.20	-2.10		4.80							
553	5	A-7	TNT	8.0	8.0	2.00	-4.20	-2.10		4.40							
554	5	B-1	TNT	8.0	8.0	2.00	-4.20	-2.10		4.75							
555	5	B-2	TNT	8.0	8.0	2.00	-4.20	-2.10		5.35							
556	5	B-3	TNT	8.0	8.0	2.00	-4.20	-2.10		5.25							
557	5	B-4	TNT	8.0	8.0	2.00	-4.20	-2.10		5.25							
558	5	B-5	TNT	8.0	8.0	2.00	-4.20	-2.10		5.50							
559	5	B-6	TNT	8.0	8.0	2.00	-4.20	-2.10		5.25							

Table 1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired with Shaped Charges (Continued)														
Silty sandy clay (Continued)																	
560	5	B-7	TNT	8.0	8.0	2.00	-4.20	-2.10		5.55							
561	5	B-8	TNT	8.0	8.0	2.00	-4.20	-2.10		5.25							
562	5	B-9	TNT	8.0	8.0	2.00	-4.20	-2.10		5.15							
563	5	B-10	TNT	64	64	4.00	-8.40	-2.10		9.90							
564	5	B-12	TNT	64	64	4.00	-8.40	-2.10		9.35							
Various soils																	
565	5	A-1	TNT	8.0	8.0	2.00	-4.20	-2.10		4.15							
566	5	A-2	TNT	8.0	8.0	2.00	-4.20	-2.10		4.65							
567	5	A-4	TNT	8.0	8.0	2.00	-4.20	-2.10		4.25							
568	5	A-10	TNT	64	64	4.00	-8.40	-2.10		8.00							
569	5	A-11	TNT	64	64	4.00	-8.40	-2.10		8.75							
570	5	A-12	TNT	216	216	6.00	-12.60	-2.10		8.95							
571	5	A-14	TNT	308	308	6.75	-14.20	-2.10		11.50							
572	5	A-15	TNT	308	308	6.75	-14.20	-2.10		14.25							
573	5	A-16	TNT	308	308	6.75	-14.20	-2.10		13.50							
574	5	A-17	TNT	64	64	4.00	-8.40	-2.10		8.80							
575	5	A-18	TNT	512	512	8.00	-16.80	-2.10		15.00							
576	5	A-19	50/50 Amatol	540			-17.00			16.25							
577	5	A-20	50/50 Amatol	540			-17.00			18.75							
578	5	A-21	TNT	512	512	8.00	-16.80	-2.10		15.75							
579	5	A-22	TNT	512	512	8.00	-16.80	-2.10		17.50							
580	5	A-23	TNT	216	216	6.00	-12.60	-2.10		12.50							
581	5	A-26	50/50 Amatol	1,080			-21.00		8.40	22.10	-2.0	39	3,130				
582	5	A-27	50/50 Amatol	1,080			-21.00		4.80	23.50	1.70	23	2,515				
583	5	A-28	TNT	1,000	1,000	10.00	-21.00	-2.10	6.90	19.25	-2.30	27	2,640				
584	5	A-29	50/50 Amatol	3,200			-31.00		9.80	23.50	3.80	32	3,135				

Table 1 (Concluded)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
					Shots Fired with Shaped Charges (Continued)												
Various soils (Continued)																	
585	5	A-30	50/50 Amatol	3,200			-31.00		7.50	31.00		14	7,030				
586	5	A-31	50/50 Amatol	3,200			-31.00		8.00	24.00	0.60	17	4,510				
587	5	B-16	TNT	216	216	6.00	-12.60	-2.10		10.25							
588	5	B-17	TNT	512	512	8.00	-16.80	-2.10		12.95							
589	5	B-18	TNT	512	512	8.00	-16.80	-2.10		17.00							
590	5	B-19	TNT	512	512	8.00	-16.80	-2.10		16.00							
591	5	B-20	50/50 Amatol	540			-17.00			19.50							
592	5	B-21	50/50 Amatol	540			-17.00			17.00							
593	5	B-22	50/50 Amatol	540			-17.00			15.00							
594	5	B-23	50/50 Amatol	540			-17.00			17.25							
595	5	B-24	TNT	216	216	6.00	-12.60	-2.10		12.30							
596	5	B-27	TNT	1,000	[illegible]	10.00	-21.00	-2.10	6.00	15.50	1.40	26	1,675				
597	5	B-28	TNT	1,000	[illegible]	10.00	-21.00	-2.10	9.60	16.50	0.50	22	2,130				
598	5	B-29	50/50 Amatol	1,080			-21.00			21.10							
599	5	B-30	50/50 Amatol	1,080			-21.00			15.50							
600	5	B-31	50/50 Amatol	1,080			-21.00			15.50							

Table 2

Results of Camouflet Measurements in Soil

(1 of 2 sheets)

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					CAMOUFLET			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	D_v FT	D_h FT	r_f FT	V_c CU FT
			Shots Fired in Moist Clay														
601	39	60	C-4	1.0	1.0	1.00	-3.50	-3.50	-0.58**	3.50		22		2.35	2.26		7.17
602	39	61	C-4	1.0	1.0	1.00	-4.00	-4.00	-0.19**	3.00		19		2.30	2.38		6.54
603	39	72	C-4	1.0	1.0	1.00	-4.25	-4.25	-0.50**	4.00		21		2.10	2.30	4.50	5.87
604	39	62	C-4	1.0	1.0	1.00	-4.50	-4.50	-0.12**	3.50				2.20	2.18		5.79
605	39	74	C-4	0.5	0.5	0.79	-5.56	-7.00	-0.01**	3.50				1.81	1.50		1.58
606	39	65	C-4	1.0	1.0	1.00	-7.00	-7.00	-0.03**	3.00				2.09	2.22	3.50	5.28
607	39	77	C-4	0.5	0.5	0.79	-9.13	-11.50	0.00					1.80	1.54		2.42
608	39	81	C-4	0.5	0.5	0.79	-9.52	-12.00	0.00					1.95	1.92		3.44
			Shots Fired in Moist Loess														
609	39	44	C-4	0.5	0.5	0.79	-2.18	-2.75	-0.67**	3.00		29		1.65	1.50	4.00	1.93
610	39	43	C-4	0.5	0.5	0.79	-2.50	-3.15	-0.28**	3.20		16		1.65	1.50	3.90	1.98
611	39	49	C-4	0.5	0.5	0.79	-2.50	-3.15	-0.51**	3.00		25		1.60	1.50	4.60	1.81
612	39	30	C-4	1.0	1.0	1.00	-3.25	-3.25	-0.48**	4.50		18		2.19	2.34		6.11
613	39	32	C-4	1.0	1.0	1.00	-3.25	-3.25	-0.55**	4.50		20		2.22	2.24	5.30	6.04
614	39	9	C-4	1.0	1.0	1.00	-3.50	-3.50	-0.84**	4.00		28		2.34	2.30	5.25	6.17
615	39	10	C-4	1.0	1.0	1.00	-3.75	-3.75	-0.63**	4.00		24		2.52	2.40	4.50	7.51
616	39	14	C-4	1.0	1.0	1.00	-3.75	-3.75	-0.45**	5.00		16		2.30	2.00	6.00	4.46
617	39	37	C-4	0.5	0.5	0.79	-3.00	-3.78	-0.36**	3.00		20		1.77	1.62	3.75	2.36
618	39	55	C-4	0.5	0.5	0.79	-3.00	-3.78	-0.26**	3.00		16		1.74	1.68	3.50	2.74
619	39	41	C-4	0.5	0.5	0.79	-3.10	-3.90	-0.26**	2.80		16		1.77	1.72	5.00	2.76
620	39	45	C-4	0.5	0.5	0.79	-3.10	-3.90	-0.17**	3.20		9		1.70	1.60	5.00	2.36
621	39	11	C-4	1.0	1.0	1.00	-4.00	-4.00	-0.30**	4.00		12		2.34	2.20	6.00	5.74
622	39	13	C-4	1.0	1.0	1.00	-4.00	-4.00	-0.31**	4.50		12		2.11	2.00	5.50	4.48
623	39	20	C-4	1.0	1.0	1.00	-4.00	-4.00	-0.31**	2.25		22		2.59	2.50	6.40	7.62
624	39	38	C-4	0.5	0.5	0.79	-3.25	-4.10	-0.30**	3.00		17		1.56	1.52	5.00	1.89
625	39	46	C-4	0.5	0.5	0.79	-3.25	-4.10	-0.27**	3.00		16		1.85	1.80	5.00	2.92
626	39	84	C-4	0.125	0.125	0.50	-2.50	-5.00						1.00	1.05		0.997

* Numbers correspond to Bibliography numbers. ** Above original ground surface.

Table 2 (Continued)

(2 of 2 sheets)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	CAMOUFLET: D_v FT	CAMOUFLET: D_h FT	CAMOUFLET: r_f FT	CAMOUFLET: V_c CU FT
			Shots Fired in Moist Loess (Continued)														
627	39	85	C-4	0.125	0.125	0.50	-2.50	-5.00						0.95	1.05		0.952
628	39	82	C-4	8.0	8.0	2.00	-10.00	-5.00						4.84	4.83		60.28
629	39	83	C-4	8.0	8.0	2.00	-10.00	-5.00						5.13	5.30		78.91
630	39	1	C-4	1.0	1.0	1.00	-6.00	-6.00	-0.02**	3.00				1.83	1.72		2.81
631	39	2	C-4	1.0	1.0	1.00	-6.00	-6.00	-0.05**	4.00				2.46	2.38		7.58
632	39	7	C-4	1.0	1.0	1.00	-6.00	-6.00	-0.04**	4.00				2.32	2.28		6.76
633	39	3	C-4	1.0	1.0	1.00	-8.00	-8.00	-0.01**	4.50				2.70	2.70		10.10
634	39	4	C-4	1.0	1.0	1.00	-8.00	-8.00	-0.02**	4.00				2.69	2.42		8.18
635	39	5	C-4	1.0	1.0	1.00	-10.00	-10.00	-0.01**	3.50				2.55	2.56		8.69
636	39	6	C-4	1.0	1.0	1.00	-10.00	-10.00						2.50	2.52	6.00	8.10
637	39	8	C-4	1.0	1.0	1.00	-14.00	-14.00	0.00					2.43	2.40		6.98

** Above original ground surface.

Table 3 (1 of 21 sheets)

Results of Crater Measurements in Frozen Ground

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
638	23	103	Military C-3	19.61			-1.06		2.24	5.31			68.79				
639	22	311	Coalite 7-S	0.66			-0.42		0.79	1.04			1.00				
640	22	312	Coalite 7-S	0.66			-0.42		0.94	1.14			1.41				
641	22	313	Coalite 7-S	0.66			-0.42		0.79	1.28			1.42				
642	23	104	Military C-3	19.51			-1.53		3.14	5.65			94.05				
643	22	292	Gelodyn 1	0.38			-0.43		0.71	1.16			1.31				
644	22	293	Gelodyn 1	0.38			-0.43		0.79	0.99			1.01				
645	22	294	Gelodyn 1	0.38			-0.43		Waterlogged crater								
646	23	140	Coalite 7-S	20.04			-1.80		3.39	4.16			87.07				
647	22	279	60% gelatin	0.22			-0.46		0.79	1.21			1.00				
648	22	10	Gelodyn 1	0.488			-0.56		1.00	1.29			1.89				
649	22	19	Coalite 7-S	0.483			-0.56		1.20	1.20			1.66				
650	23	82	Military C-3	0.50			-0.57		0.95	1.41			3.28				
651	22	18	Coalite 7-S	0.560			-0.59		0.96	1.70			3.06				
652	52	1	Pentolite	2.65			-1.0		2.6	2.7			26.1				
653	52	2	Pentolite	2.65			-1.0		2.5	3.0			33.6				
654	52	3	Pentolite	2.65			-1.0		2.4	3.2			25.1				
655	52	4	Pentolite	2.65			-1.0		2.4	3.1			44.5				
656	52	5	Pentolite	2.65			-1.0		2.2	2.9			39.5				
657	52	6	Pentolite	2.65			-1.0		1.7	2.7			22.5				
658	52	7	Pentolite	2.65			-1.0		1.5	3.5			19				
659	52	8	Pentolite	2.65			-1.0		1.7	2.9			21.2				
660	52	9	Pentolite	2.65			-1.0		1.2	2.9			16.1				
661	52	10	Pentolite	2.65			-1.0		1.7	3.7			16.6				
662	52	11	Pentolite	2.65			-1.0		1.9	3.3			21.1				
663	52	12	Pentolite	2.65			-1.0		1.9	3.4			27.6				
664	52	13	Pentolite	2.65			-1.0		1.5	3.1			13.3				
665	52	14	Pentolite	2.65			-1.0		1.8	3.7			12.8				

* Numbers correspond to Bibliography numbers.

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
666	52	106	C-3	2.65			-1.0		1.9	4.0			25.0				
667	22	296	Coalite 7-S	0.85			-0.69										
668	23	94	Military C-3	1.00			-0.73		1.28	2.08			6.24				
669	22	277	60% gelatin	0.22			-0.45		0.79	1.17			1.36				
670	22	278	60% gelatin	0.22			-0.45		0.81	1.03			1.04				
671	22	1	60% gelatin	0.472			-0.58		1.0	1.52			2.42				
672	23	115-R	Coalite 7-S	1.98			-0.95		1.82	2.56			18.48				
673	22	308	Coalite 7-S	0.66			-0.66		1.23	1.49			3.17				
674	22	309	Coalite 7-S	0.66			-0.66		1.12	1.17			1.88				
675	22	310	Coalite 7-S	0.66			-0.66		1.25	1.23			2.37				
676	22	11	Gelodyn 1	0.425			-0.58		0.96	1.44			2.31				
677	23	105	Military C-3	19.39			-2.06		3.35	5.28			105.77				
678	23	83	Military C-3	0.50			-0.63		1.06	1.69			4.83				
679	22	244	80% gelatin	0.20			-0.48		0.83	1.20			1.72				
680	22	245	80% gelatin	0.20			-0.48		0.87	1.12			1.35				
681	22	246	80% gelatin	0.20			-0.48		0.79	1.03			0.90				
682	22	297	Coalite 7-S	1.30			-0.83		1.00	1.05			1.15				
683	23	62	Military C-3	1.19			-1.02		1.57	2.92			14.03				
684	22	2	60% gelatin	0.412			-0.60		2.50	1.50			3.64				
685	22	20	Coalite 7-S	0.413			-0.61		1.04	1.48			2.30				
686	23	36	Atlas 60	1.90			-1.02		1.58	2.33			10.09				
687	23	116-R	Coalite 7-S	1.98			-1.09		1.83	2.53			17.60				
688	22	3	60% gelatin	0.353			-0.64		2.16	1.17			3.04				
689	23	74	Military C-3	4.90			-1.52		2.36	4.01			44.70				
690	23	84	Military C-3	0.50			-0.71		0.99	1.83			3.67				
691	23	54	Atlas 60	19.04			-2.46		4.00	5.77			121.25				
692	23	141	Coalite 7-S	20.05			-2.51		3.94	5.13			140.83				
693	22	291	Gelodyn 1	0.38			-0.67		1.06	1.17			1.64				

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
694	23	46	Atlas 60	4.82			-1.57		2.34	3.90			31.77				
695	22	289	Gelodyn 1	0.38			-0.68		1.08	1.30			2.00				
696	22	290	Gelodyn 1	0.38			-0.68		0.98	1.38			2.40				
697	22	13	Gelodyn 1	0.307			-0.64		1.42	1.10			1.87				
698	22	12	Gelodyn 1	0.362			-0.08		1.25	0.99			1.51				
699	23	85	Military C-3	0.50			-0.76		0.96	1.83			3.54				
700	23	106	Military C-3	19.52			-2.58		4.19	5.86			175.11				
701	22	21	Coalite 7-S	0.350			-0.68		1.29	1.36			1.92				
702	22	47	Gelodyn 1	0.486			-0.76		1.50	1.44			3.08				
703	23	28	Atlas 60	0.95			-0.96		1.45	2.01			5.22				
704	23	37	Atlas 60	1.90			-1.22		1.69	3.14			12.63				
705	22	38	60% gelatin	0.472			-0.77		1.75	1.58			3.70				
706	23	22	Atlas 60	0.48			-0.77		1.15	1.90			3.74				
707	23	133	Coalite 7-S	4.93			-1.68		2.47	3.16			43.25				
708	22	37	60% gelatin	0.029			-0.31										
709	22	56	Coalite 7-S	0.562			-0.84		1.50	1.14			2.52				
710	23	63	Military C-3	1.99			-1.28		2.13	2.01			14.88				
711	22	305	Coalite 7-S	0.66			-0.92		1.58	1.27			2.60				
712	22	306	Coalite 7-S	0.66			-0.92		1.46	1.35			3.00				
713	22	307	Coalite 7-S	0.66			-0.92		1.83	1.43			4.29				
714	23	134	Coalite 7-S	4.92			-1.83		2.77	3.10			36.00				
715	22	39	60% gelatin	0.413			-0.81		2.08†	1.51			5.66				
716	23	117	Coalite 7-S	1.98			-1.37		1.88	2.43			12.88				
717	52	15	Pentolite	2.65			-1.5		2.2	3.8			18.5				
718	52	16	Pentolite	2.65			-1.5		2.1	3.6			19.0				
719	52	17	Pentolite	2.65			-1.5		1.8	3.6			22.4				
720	52	18	Pentolite	2.65			-1.5		2.4	3.0			19.2				
721	52	19	Pentolite	2.65			-1.5		2.3	3.3			23.0				

† Broke through interface of unfrozen ground.

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
722	52	20	Pentolite	2.65			-1.5		2.1	3.1			20.8				
723	52	21	Pentolite	2.65			-1.5		2.0	3.4			22.0				
724	52	22	Pentolite	2.65			-1.5		2.2	4.3			42.6				
725	52	23	Pentolite	2.65			-1.5		2.4	2.9			25.9				
726	52	24	Pentolite	2.65			-1.5		1.7	2.4			11.9				
727	52	25	Pentolite	2.65			-1.5		2.0	2.8			11.5				
728	52	26	Pentolite	2.65			-1.5		2.3	2.7			19.8				
729	52	27	Pentolite	2.65			-1.5		1.9	2.6			15.5				
730	52	28	Pentolite	2.65			-1.5		1.8	2.7			18.5				
731	52	107	C-3	2.65			-1.5		1.8	3.7			22.5				
732	23	107	Military C-3	19.96			-2.97		4.53	6.45			208.28				
733	23	142	Coalite 7-S	20.06			-2.98		4.65	5.79			253.92				
734	23	55	Atlas 60	19.03			-2.96		4.35	6.22			161.64				
735	22	48	Gelodyn 1	0.424			-0.84		2.66†	1.45			7.17				
736	23	47	Atlas 60	4.81			-1.90		2.89	4.14			35.72				
737	23	38	Atlas 60	1.89			-1.40		2.17	3.38			17.44				
738	22	4	60% gelatin	0.294			-0.75		1.42	1.41			2.75				
739	22	57	Coalite 7-S	0.484			-0.90		2.08	1.41			4.83				
740	23	95	Military C-3	1.00			-1.14		1.66	2.50			11.52				
741	22	275	60% gelatin	0.22			-0.69		0.83	1.08			1.34				
742	22	14	Gelodyn 1	0.244			-0.71		1.12	1.12			1.89				
743	22	22	Coalite 7-S	0.274			-0.75		1.04	1.31			2.10				
744	23	64-R	Military C-3	2.00			-1.45		2.11	3.34			26.34				
745	23	86	Military C-3	0.50			-0.92		1.20	1.68			3.31				
746	22	274	60% gelatin	0.22			-0.70		0.90	1.09			1.38				
747	22	276	60% gelatin	0.22			-0.70		0.96	1.23			2.04				
748	22	40	60% gelatin	0.35			-0.83		2.42†	1.56			5.95				
749	23	64	Military C-3	1.99			-1.48		2.10	2.26			10.96				

† Broke through interface of unfrozen ground.

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
750	22	5	60% gelatin	0.236			-0.73		1.16	1.15			1.71				
751	22	49	Gelodyn 1	0.364			-0.85		2.00	1.43			4.16				
752	23	135	Coalite 7-S	4.94			-2.04		2.96	2.96			41.12				
753	23	29	Atlas 60	0.95			-1.19		1.67	2.07			9.46				
754	23	75	Military C-3	4.94			-2.05		2.89	3.79			40.00				
755	22	15	Gelodyn 1	0.181			-0.70		0.92	1.31			1.67				
756	23	48	Atlas 60	4.69			-2.06		2.84	4.32			34.56				
757	23	87	Military C-3	0.50			-0.98		1.31	2.28			5.72				
758	22	58	Coalite 7-S	0.415			-0.94		2.25	1.36			4.54				
759	22	241	80% gelatin	0.20			-0.73		1.12	1.13			2.76				
760	22	242	30% gelatin	0.20			-0.73		1.00	1.00			1.19				
761	22	243	80% gelatin	0.20			-0.73		1.15	1.24			2.22				
762	22	288	Gelodyn 1	0.38			-0.92		1.25	1.33			2.67				
763	23	56	Atlas 60	19.13			-3.44		4.94	5.58			161.79				
764	23	143	Coalite 7-S	20.10			-3.48		4.40	5.89			229.86				
765	22	36	60% gelatin	0.029			-0.40		0.58	0.77			0.39				
766	22	286	Gelodyn 1	0.38			-0.93		1.29	1.10			2.33				
767	22	287	Gelodyn 1	0.38			-0.93		1.31	1.41			3.44				
768	23	118	Coalite 7-S	1.96			-1.61		2.30	2.87			21.87				
769	22	23	Coalite 7-S	0.210			-0.79		1.17	1.04			1.37				
770	22	302	Coalite 7-S	0.66			-1.17		1.83	1.57			6.35				
771	22	303	Coalite 7-S	0.66			-1.17		2.21	1.54			6.16				
772	22	304	Coalite 7-S	0.66			-1.17		1.87	1.42			5.40				
773	23	108	Military C-3	19.59			-3.63		5.09	6.82			287.14				
774	23	96	Military C-3	1.00			-1.35		1.70	2.48			8.66				
775	22	41	60% gelatin	0.295			-0.91		2.33†	1.69			6.78				
776	22	50	Gelodyn 1	0.303			-0.91		2.50	1.54			5.83				
777	22	59	Coalite 7-S	0.346			-0.95		2.25	1.70			6.98				

† Broke through interface of unfrozen ground.

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
778	23	136	Coalite 7-S	4.92			-2.34		3.31	3.83			49.86				
779	22	42	60% gelatin	0.236			-0.87		1.50	1.67			3.95				
780	23	39	Atlas 60	1.90			-1.74		2.37	3.51			22.31				
781	23	119	Coalite 7-S	1.98			-1.76		2.56	2.84			23.78				
782	23	65	Military C-3	1.99			-1.77		2.48	2.70			22.73				
783	22	6	60% gelatin	0.177			-0.79		1.00	0.97			1.45				
784	23	2	Atlas 60	1.96			-1.76		2.67	2.67			13.32				
785	22	320	Coalite 7-S	0.26			-0.91		1.29	1.09			2.11				
786	23	23	Atlas 60	0.48			-1.11		1.51	2.12			5.75				
787	22	24	Coalite 7-S	0.140			-0.75		1.08	1.25			1.87				
788	23	30	Atlas 60	0.92			-1.40		1.86	2.30			8.61				
789	23	6	Atlas 60	1.92			-1.79		2.46	2.88			17.41				
790	23	7	Atlas 60	1.92			-1.79		2.65	2.53			11.03				
791	23	12	Atlas 60	1.94			-1.80		2.62	3.00			15.80				
792	22	317	Coalite 7-S	0.26			-0.93		1.33	1.32			2.46				
793	22	318	Coalite 7-S	0.26			-0.93		1.40	1.10			1.82				
794	22	319	Coalite 7-S	0.26			-0.93			0.56		No crater					
795	52	29	Pentolite	2.65			-2.0		2.3	4.0			36.4				
796	52	30	Pentolite	2.65			-2.0		2.2	3.3			26.3				
797	52	31	Pentolite	2.65			-2.0		2.4	3.5			26.9				
798	52	32	Pentolite	2.65			-2.0		1.5	4.0			35.8				
799	52	33	Pentolite	2.65			-2.0		1.9	3.1			20.4				
800	52	34	Pentolite	2.65			-2.0		2.1	3.3			19.1				
801	52	35	Pentolite	2.65			-2.0		2.3	3.4			27.5				
802	52	36	Pentolite	2.65			-2.0		3.0	3.3			24.5				
803	52	37	Pentolite	2.65			-2.0		1.7	3.4			17.7				
804	52	38	Pentolite	2.65			-2.0		2.7	3.4			26.5				
805	52	39	Pentolite	2.65			-2.0		1.7	3.9			25.7				

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
806	52	4C	Pentolite	2.65			-2.0		2.2	3.2			28.1				
807	52	41	Pentolite	2.65			-2.0		1.7	3.4			20.7				
808	52	42	Pentolite	2.65			-2.0		1.7	3.1			14.2				
809	52	108	C-3	2.65			-2.0		2.5	3.7			22.7				
810	22	60	Coalite 7-S	0.277			-0.95		1.33	1.51			3.83				
811	22	169	Coalite 7-S	1.77			-1.77		3.00	3.15			39.65				
812	22	323	Coalite 7-S	0.26			-0.94		1.21	0.97			1.18				
813	22	324	Coalite 7-S	0.26			-0.94		1.29	1.27			2.58				
814	22	325	Coalite 7-S	0.26			-0.94		1.29	1.32			2.73				
815	22	160	Coalite 7-S	0.44			-1.12		2.29	1.27			4.48				
816	23	88-R	Military C-2	0.50			-1.16		1.53	2.37			5.87				
817	22	316-A	Coalite 7-S	0.26			-0.95		1.60	1.04			1.70				
818	22	321	Coalite 7-S	0.26			-0.95			0.96		No crater					
819	22	322	Coalite 7-S	0.26			-0.95			0.89		No crater					
820	22	163	Coalite 7-S	0.75			-1.35		2.50	1.69			9.44				
821	22	166	Coalite 7-S	1.18			-1.57		2.92	2.24			19.34				
822	23	9	Atlas 60	1.92			-1.84		2.55	2.88			14.36				
823	23	11	Atlas 60	1.92			-1.84		2.67	3.14			15.05				
824	23	49	Atlas 60	4.70			-2.49		3.53	4.56			48.63				
825	23	57	Atlas 60	18.99			-3.97		5.54	6.44			232.51				
826	22	326	Coalite 7-S	0.26			-0.96			0.69		No crater					
827	22	327	Coalite 7-S	0.26			-0.96			0.58		No crater					
828	22	328	Coalite 7-S	0.26			-0.96			0.67		No crater					
829	23	3	Atlas 60	1.95			-1.88		2.41	2.51			13.54				
830	23	109	Military C-3	19.68			-4.05		5.45	6.40			275.36				
831	22	157	Coalite 7-S	0.225			-0.92		1.33	1.15			1.16				
832	22	162	Coalite 7-S	0.60			-1.27		2.75	1.81			9.82				
833	23	144	Coalite 7-S	20.16			-4.11††		4.57	5.35			167.33				

†† Shot fired in drift area.

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
834	23	4	Atlas 60	1.93			-1.88		2.31	2.86			13.76				
835	23	76	Military C-3	4.92			-2.59		3.47	4.05			65.13				
836	23	8	Atlas 60	1.91			-1.90		2.52	2.96			15.02				
837	23	146	Coalite 7-S	20.14			-4.17		5.56	5.18			240.01				
838	22	16	Gelodyn 1	0.125			-0.77		1.00	1.17			1.69				
839	22	35	60% gelatin	0.029			-0.48		0.62	1.15			1.18				
840	22	272	60% gelatin	0.22			-0.93		1.46	1.39			2.85				
841	22	73	Coalite 7-S	0.207			-0.92			Charging error							
842	22	316	Coalite 7-S	0.26			-1.00			0.35		No crater					
843	23	1	Atlas 60	1.86			-1.92		2.67	2.45			13.29				
844	23	10	Atlas 60	1.93			-1.95		2.75	2.84			12.13				
845	23	66	Military C-3	1.99			-1.96		2.79	3.30			27.63				
846	22	7	60% gelatin	0.118			-0.77		1.00	1.26			1.41				
847	23	5	Atlas 60	1.92			-1.95		7.75	2.57			18.72				
848	22	51	Gelodyn 1	0.242			-0.98		1.59	1.74			5.07				
849	23	16	Atlas 60	1.93			-1.98		2.34	3.03			28.65				
850	22	91	Coalite 7-S	0.191			-0.92				Crater						
851	23	40	Atlas 60	1.88			-1.96		2.56	3.24			17.63				
852	22	224	80% gelatin	0.11			-0.77										
853	22	273	60% gelatin	0.22			-0.96		1.50	1.25			2.84				
854	23	41	Atlas 60	1.91			-1.98		2.54	3.34			26.26				
855	22	156	Coalite 7-S	0.185			-0.92		2.08	1.15			3.25				
856	22	76	Coalite 7-S	0.207			-0.95				Crater						
857	22	85	Coalite 7-S	0.207			-0.95										
858	22	314	Coalite 7-S	0.26			-1.03			0.63		No crater					
859	22	315	Coalite 7-S	0.26			-1.03			0.33		No crater					
860	22	61	Coalite 7-S	0.205			-0.96		1.92	1.49			4.48				
861	22	159	Coalite 7-S	0.365			-1.12		1.92	1.33			4.01				

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
862	22	285	Gelodyn 1	0.38			-1.17		1.46	1.60			5.06				
863	22	271	60% gelatin	0.22			-0.98		1.73	1.34			3.00				
864	22	260	Coalite 7-S	0.66			-1.42				No crater						
865	22	299	Coalite 7-S	0.66			-1.42		0.0	0.65		No crater					
866	22	300	Coalite 7-S	0.66			-1.42		1.92	1.90			7.09				
867	22	301	Coalite 7-S	0.66			-1.42		2.29	1.30			3.62				
868	22	165	Coalite 7-S	0.954			-1.60		3.42	1.90			17.09				
869	23	145	Coalite 7-S	20.10			-4.44††		5.17	5.83			293.40				
870	22	43	60% gelatin	0.177			-0.92		1.42	1.40			3.55				
871	22	110	Coalite 7-S	0.178			-0.93										
872	22	283	Gelodyn 1	0.38			-1.18		1.90	1.36			4.06				
873	22	284	Gelodyn 1	0.38			-1.18		1.80	1.18			3.50				
874	22	262	Coalite 7-S	0.68			-1.44										
875	22	263	Coalite 7-S	0.68			-1.44										
876	22	168	Coalite 7-S	1.40			-1.84		3.25	3.19			39.15				
877	22	269	Coalite 7-S	0.63			-1.42				No crater						
878	22	261	Coalite 7-S	0.68			-1.45										
879	22	264	Coalite 7-S	0.68			-1.45				No crater						
880	23	13	Atlas 60	1.89			-2.05		2.71	3.20			30.85				
881	23	14	Atlas 60	1.93			-2.06		2.66	2.92			26.42				
882	23	18	Atlas 60	1.99			-2.08		2.59	3.44			36.44				
883	23	110	Military C-3	19.84			-4.48		5.90	7.08			353.87				
884	22	295	Coalite 7-S	0.025			-0.48										
885	22	72	Coalite 7-S	0.179			-0.93				Charging error						
886	22	96	Coalite 7-S	0.191			-0.96				Crater						
887	22	97	Coalite 7-S	0.191			-0.96				Crater						
888	23	120	Coalite 7-S	1.97			-2.08		2.75	3.30			32.46				
889	22	112	Coalite 7-S	0.178			-0.94		1.25	1.26			2.11				

†† Shot fired in drift area.

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
890	22	240	30% gelatin	0.20			-0.97		1.29	1.30			2.63				
891	23	58	Atlas 60	19.21			-4.48		6.46	7.04			306.85				
892	22	238	30% gelatin	0.20			-0.98		1.25	1.19			2.15				
893	22	239	30% gelatin	0.20			-0.98		1.35	1.03			2.25				
894	23	24	Atlas 60	0.48			-1.32		1.70	2.57			7.70				
895	22	84	Coalite 7-S	0.179			-0.95										
896	22	52	Gelodyn 1	0.181			-0.97		2.00	1.26			3.09				
897	23	31	Atlas 60	0.94			-1.67		2.15	2.69			17.97				
898	22	111	Coalite 7-S	0.178			-0.96										
899	22	90	Coalite 7-S	0.191			-0.99				No crater						
900	23	17	Atlas 60	1.92			-2.13		2.66	3.70			45.21				
901	22	75	Coalite 7-S	0.179			-0.97				Crater						
902	22	134	60% gelatin	0.302			-1.16										
903	23	67-R	Military C-3	2.00			-2.21		2.88	3.79			36.51				
904	22	102	Coalite 7-S	0.165			-0.97				No crater						
905	22	103	Coalite 7-S	0.165			-0.97				No crater						
906	23	15	Atlas 60	1.91			-2.18		2.74	3.28			40.43				
907	22	175	Gelodyn 1	0.14			-0.92				No crater						
908	22	83	Coalite 7-S	0.153			-0.96				No crater						
909	23	126	Coalite 7-S	4.93			-3.02			3.98							
910	22	223	80% gelatin	0.08			-0.77				Crater						
911	22	167	Coalite 7-S	1.07			-1.83		3.08	1.70			8.69				
912	23	50	Atlas 60	4.78			-3.01		3.13	4.69			67.45				
913	22	164	Coalite 7-S	0.71			-1.60		1.56	1.10			3.65				
914	52	43	Pentolite	2.65			-2.5		2.1	3.3			21.5				
915	52	44	Pentolite	2.65			-2.5		2.1	3.6			17.2				
916	52	45	Pentolite	2.65			-2.5		1.7	3.7			19.6				
917	52	46	Pentolite	2.65			-2.5		2.2	3.7			28.3				

Table 3 (Continued)

(11 of 21 sheets)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
918	52	47	Pentolite	2.65			-2.5		3.1	4.8			39.1				
919	52	48	Pentolite	2.65			-2.5		2.5	3.7			34.5				
920	52	49	Pentolite	2.65			-2.5		2.7	4.2			48.5				
921	52	50	Pentolite	2.65			-2.5		2.8	5.0			58.6				
922	52	51	Pentolite	2.65			-2.5		2.6	4.1			34.5				
923	52	52	Pentolite	2.65			-2.5		2.9	4.5			56.3				
924	52	53	Pentolite	2.65			-2.5		3.5	5.1			107.5				
925	52	54	Pentolite	2.65			-2.5		3.3	3.9			54.1				
926	52	55	Pentolite	2.65			-2.5		3.3	4.0			66.5				
927	52	56	Pentolite	2.65			-2.5		3.6	4.2			50.6				
928	52	109	C-3	2.65			-2.5		No crater								
929	22	34	60% gelatin	0.029			-0.56		0.71	0.97			0.75				
930	22	71	Coalite 7-S	0.153			-0.98		Charging error								
931	23	97	Military C-3	1.00			-1.81		2.34	2.91			17.73				
932	22	298	Coalite 7-S	0.180			-1.02		1.21	1.2			1.82				
933	23	67	Military C-3	1.99			-2.29		2.73	3.77			32.96				
934	22	74	Coalite 7-S	0.153			-0.99		No crater								
935	22	161	Coalite 7-S	0.44			-1.40		2.75	0.80			0.80				
936	22	158	Coalite 7-S	0.27			-1.20		2.08	0.00							
937	23	111	Military C-3	19.87			-5.01		6.39	6.91			459.05				
938	23	121	Coalite 7-S	1.96			-2.33		3.23	3.06			48.24				
939	23	59	Atlas 60	19.26			-4.98		6.32	6.71			294.18				
940	22	178	Gelodyn 1	0.44			-1.42										
941	23	42	Atlas 60	1.92			-2.32		3.03	4.25			54.10				
942	22	172	Gelodyn 1	0.075			-0.79		No crater								
943	22	174	Gelodyn 1	0.115			-0.92		No crater								
944	22	89	Gelodyn 1	0.125			-0.94		Crater								
945	22	181	Gelodyn 1	1.43			-2.12		3.79	2.83			42.63				

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
946	23	127	Coalite 7-S	5.00			-3.24		4.15	4.46			76.76				
947	22	62	Coalite 7-S	0.138			-0.99			No crater							
948	22	201	80% gelatin	0.090			-0.86			0.63	2-in. crater						
949	23	77	Military C-3	4.05			-3.06		3.72	4.87			75.35				
950	22	70	Gelodyn 1	0.125			-0.96										
951	23	147	Coalite 7-S	20.15			-5.22††		5.87	6.23			355.33				
952	22	25	Coalite 7-S	0.070			-0.79		0.15	0.40			0.03				
953	22	199	80% gelatin	0.085			-0.85		1.15	1.81			2.99				
954	22	200	80% gelatin	0.090			-0.87		1.21	1.38			1.82				
955	22	202	80% gelatin	0.100			-0.89			1.00	3-in. crater						
956	22	203	80% gelatin	0.100			-0.89		1.21	2.23			4.72				
957	23	123	Coalite 7-S	1.98			-2.43		3.27	0.81			4.26				
958	22	185	Gelodyn 1	14.82			-4.75			9.56							
959	22	53	Gelodyn 1	0.122			-0.97		0.15	0.75			0.11				
960	23	32	Atlas 60	0.95			-1.90		2.33	3.24			19.01				
961	23	66-R	Military C-3	2.00			-2.45		3.14	3.94			43.00				
962	22	255	Gelodyn 1	0.39			-1.42										
963	23	89	Military C-3	0.50			-1.54		1.99	2.75			17.50				
964	22	82	Gelodyn 1	0.125			-0.98										
965	22	17	Gelodyn 1	0.063			-0.79		0.17	0.48			0.04				
966	22	28	Coalite 7-S	0.063			-0.79		0.08	0.31			0.00				
967	22	198	80% gelatin	0.085			-0.87		0.25	0.33			0.04				
968	22	88	Gelodyn 1	0.125			-0.99				Crater						
969	22	268	60% gelatin	0.22			-1.19		1.50	1.74			5.10				
970	23	68	Military C-3	1.99			-2.49		3.04	3.09			27.90				
971	22	254	Gelodyn 1	0.38			-1.43										
972	22	280	Gelodyn 1	0.38			-1.43		2.67	0.84			2.57				
973	22	281	Gelodyn 1	0.38			-1.43		1.92	1.59			4.43				

†† Shot fired in drift area.

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
974	22	282	Gelodyn 1	0.38			-1.43		2.00	0.65			0.75				
975	22	182	Gelodyn 1	2.70			-2.77		4.58	6.56			197.16				
976	22	69	Gelodyn 1	0.111			-0.96										
977	22	94	Gelodyn 1	0.111			-0.96				Crater						
978	22	95	Gelodyn 1	0.111			-0.96				Crater						
979	22	44	60% gelatin	0.118			-0.98		1.25	1.36			2.78				
980	22	269	60% gelatin	0.22			-1.20		1.58	1.64			3.59				
981	22	270	60% gelatin	0.22			-1.20		2.04	1.93			6.08				
982	22	177	Gelodyn 1	0.37			-1.44		2.00	1.34			2.36				
983	22	253	Gelodyn 1	0.36			-1.43										
984	22	256	Gelodyn 1	0.37			-1.45										
985	22	258	Gelodyn 1	0.37			-1.45										
986	22	184	Gelodyn 1	9.33			-4.23			9.30							
987	22	257	Gelodyn 1	0.37			-1.46				Void						
988	23	90	Military C-3	0.50			-1.61		1.97	2.73			9.53				
989	22	122	60% gelatin	0.096			-0.96		0.08	0.50			0.04				
990	22	80	Gelodyn 1	0.098			-0.94										
991	22	123	60% gelatin	0.100			-0.94		1.08	1.09			1.65				
992	22	67	60% gelatin	0.104			-0.96				Crater						
993	22	79	60% gelatin	0.104			-0.96				Crater						
994	22	100	Gelodyn 1	0.104			-0.96										
995	22	101	Gelodyn 1	0.104			-0.96										
996	22	107	Gelodyn 1	0.104			-0.96		1.25	0.76			0.57				
997	22	108	Gelodyn 1	0.104			-0.96		1.00	1.58			3.21				
998	22	109	Gelodyn 1	0.104			-0.96		0.92	1.38			1.66				
999	22	81	Gelodyn 1	0.111			-0.98										
1000	23	112	Military C-3	19.95			-5.55		6.68	9.34			647.49				
1001	22	130	60% gelatin	0.184			-1.17										

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	CRATER DIMENSIONS TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
1002	23	25	Atlas 60	0.46			-1.58		2.04	2.38			11.97				
1003	23	51	Atlas 60	4.74			-3.44		4.15	4.87			99.65				
1004	23	148	Coalite 7-S	20.12			-5.58		6.93	6.17			419.62				
1005	22	148	60% gelatin	0.321			-1.42		2.33	1.60			4.09				
1006	22	183	Gelodyn 1	5.40			-3.61			6.06							
1007	22	133	60% gelatin	0.321			-1.43			No crater							
1008	22	180	Gelodyn 1	1.18			-2.19		3.58	2.90			40.40				
1009	22	8	60% gelatin	0.059			-0.81		0.92	1.12			1.06				
1010	22	171	Gelodyn 1	0.06			-0.81			No crater							
1011	22	235	80% gelatin	0.21			-1.23		2.00	1.73			4.11				
1012	22	236	80% gelatin	0.21			-1.23		1.44	1.55			3.78				
1013	23	128	Coalite 7-S	4.96			-3.53		4.47	3.65			20.11				
1014	22	124	60% gelatin	0.103			-0.98			Muddy surface							
1015	23	43	Atlas 60	1.89			-2.60		3.37	4.18			49.64				
1016	22	78	60% gelatin	0.089			-0.95				Crater						
1017	22	121	60% gelatin	0.092			-0.95		0.21	1.27			0.41				
1018	23	19	Atlas 60	1.98			-2.66		----	4.71			15.06				
1019	23	78	Military C-3	4.81			-3.56		2.72	6.33			69.22				
1020	22	145	60% gelatin	0.184			-1.21		2.08	1.32			3.57				
1021	22	237	80% gelatin	0.20			-1.23		1.33	1.25			2.59				
1022	22	136	60% gelatin	0.505			-1.70										
1023	22	154	60% gelatin	0.749			-1.93		3.59	3.09			42.15				
1024	22	33	60% gelatin	0.029			-0.66		0.10	0.33			0.00				
1025	22	66	60% gelatin	0.089			-0.96				Crater						
1026	22	87	60% gelatin	0.090			-0.96				Crater						
1027	22	68	Gelodyn 1	0.098			-0.98										
1028	23	122	Coalite 7-S	1.97			-2.66		3.25	3.23			42.64				
1029	22	27	Gelodyn 1	0.049			-0.79										

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
1030	22	209	80% gelatin	0.082			-0.92		1.12	1.41			2.42				
1031	22	142	60% gelatin	0.085			-0.94		1.21	1.27			2.01				
1032	22	139	60% gelatin	0.750			-1.97										
1033	52	57	Pentolite	2.65			-3.0		4.0	4.8			110.0				
1034	52	58	Pentolite	2.65			-3.0		4.4	5.5			123.0				
1035	52	59	Pentolite	2.65			-3.0		3.3	4.7			74.4				
1036	52	60	Pentolite	2.65			-3.0		3.4	4.5			64.9				
1037	52	61	Pentolite	2.65			-3.0		3.6	5.4			91.2				
1038	52	62	Pentolite	2.65			-3.0		3.9	4.8			123.0				
1039	52	63	Pentolite	2.65			-3.0		3.5	5.4			80.0				
1040	52	64	Pentolite	2.65			-3.0		3.7	5.9			94.0				
1041	52	65	Pentolite	2.65			-3.0		3.1	5.1			57.9				
1042	52	66	Pentolite	2.65			-3.0		3.5	5.8			62.2				
1043	52	67	Pentolite	2.65			-3.0			No crater							
1044	52	68	Pentolite	2.65			-3.0		3.5	4.9			66.3				
1045	52	69	Pentolite	2.65			-3.0		3.1	6.0			76.8				
1046	52	70	Pentolite	2.65			-3.0		3.8	6.8			131.0				
1047	52	110	C-3	2.65			-3.0		3.7	4.9			43.2				
1048	22	173	Gelodyn 1	0.085			-0.96			No crater							
1049	22	120	60% gelatin	0.089			-0.98										
1050	22	249	60% gelatin	0.27			-1.42										
1051	22	210	80% gelatin	0.31			-1.48		2.33	1.55			5.86				
1052	22	211	80% gelatin	0.31			-1.48		2.58	1.55			7.81				
1053	22	119	60% gelatin	0.085			-0.97		----	----			0.29				
1054	22	86	60% gelatin	0.090			-0.99				Crater						
1055	23	33	Atlas 60	0.98			-2.18		2.56	3.23			21.33				
1056	23	69	Military C-3	1.99			-2.77		3.11	4.49			70.10				
1057	22	197	80% gelatin	0.075			-0.93			Collar circle							

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
1058	23	129	Coalite 7-S	4.96			-3.78		1.57	2.16			0.85				
1059	23	60	Atlas 60	19.08			-5.94										
1060	22	32	60% gelatin	0.029			-0.69		0.83	1.19			1.18				
1061	22	117	60% gelatin	0.078			-0.96		1.25	1.37			2.70				
1062	22	127	60% gelatin	0.085			-0.98										
1063	22	179	Gelodyn 1	0.87			-2.12		3.46	2.44			25.79				
1064	23	113	Military C-3	19.92			-6.03			2.24							
1065	22	196	80% gelatin	0.075			-0.94			Collar circle							
1066	22	170	Gelodyn 1	0.045			-0.81			No crater							
1067	22	147	60% gelatin	0.258			-1.44		2.08	1.66			2.89				
1068	22	222	80% gelatin	0.04			-0.77										
1069	22	207	80% gelatin	0.082			-0.97		1.25	1.68			3.50				
1070	22	151	60% gelatin	0.503			-1.81		2.75	1.61			7.55				
1071	22	118	60% gelatin	0.081			-0.98		1.25	1.27			2.29				
1072	22	132	60% gelatin	0.260			-1.46			No crater							
1073	22	214	80% gelatin	0.26			-1.46		0.25	1.20							
1074	22	215	80% gelatin	0.26			-1.46		0.33	0.62							
1075	22	176	Gelodyn 1	0.27			-1.48			No crater							
1076	23	73	Atlas 60	4.90			-3.87			0.62							
1077	22	194	80% gelatin	0.070			-0.94			Collar circle							
1078	22	195	80% gelatin	0.070			-0.94			Collar circle							
1079	22	77	60% gelatin	0.074			-0.96										
1080	22	204	80% gelatin	0.075			-0.96										
1081	22	205	80% gelatin	0.075			-0.96										
1082	22	206	80% gelatin	0.075			-0.96		1.17	1.82			3.66				
1083	22	248	60% gelatin	0.24			-1.42										
1084	22	153	60% gelatin	0.594			-1.92		3.25	3.34			19.75				
1085	23	98	Military C-3	1.00			-2.29		2.81	2.00			0.76				

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
1086	23	124	Coalite 7-S	1.98			-2.89		3.69	2.01			3.74				
1087	22	208	80% gelatin	0.082			-0.99		0.33	1.01			0.55				
1088	22	129	60% gelatin	0.146			-1.22										
1089	22	26	60% gelatin	0.044			-0.81		0.21	0.57			0.01				
1090	22	135	60% gelatin	0.406			-1.71										
1091	22	150	60% gelatin	0.406			-1.71		2.83	1.26			3.66				
1092	22	144	60% gelatin	0.147			-1.23		0.00	0.00							
1093	23	91	Military C-3	0.50			-1.86		2.18	1.77			1.70				
1094	22	138	60% gelatin	0.595			-1.95										
1095	23	79	Military C-3	4.85			-3.92		1.55	2.95			13.91				
1096	22	92	60% gelatin	0.074			-0.98				Crater						
1097	22	93	60% gelatin	0.074			-0.98				Crater						
1098	22	115	60% gelatin	0.070			-0.96				Camouflet						
1099	23	70	Military C-3	1.99			-2.95		3.41	2.32			5.45				
1100	23	150	Coalite 7-S	20.11			-6.37††		7.27	7.75			241.62				
1101	22	192	80% gelatin	0.065			-0.94			Radial cracks							
1102	22	193	80% gelatin	0.065			-0.94			Radial cracks							
1103	23	26	Atlas 60	0.46			-1.81		1.21	0.88			0.48				
1104	22	65	60% gelatin	0.074			-0.99			No crater							
1105	23	52	Atlas 60	4.77			-3.97		3.36	1.68			1.70				
1106	22	212	80% gelatin	0.22			-1.42		0.12	0.36							
1107	22	247	60% gelatin	0.22			-1.42										
1108	22	250	60% gelatin	0.22			-1.42										
1109	22	252	60% gelatin	0.22			-1.42										
1110	22	251	60% gelatin	0.22			-1.43										
1111	22	99	60% gelatin	0.067			-0.98										
1112	22	116	60% gelatin	0.074			-1.01			No crater							
1113	22	98	60% gelatin	0.067			-0.99										

†† Shot fired in drift area.

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
1114	22	63	Coalite 7-S	0.068			-0.99			No crater							
1115	22	265	60% gelatin	0.22			-1.45			0.32		No crater					
1116	22	266	60% gelatin	0.22			-1.45			0.82		No crater					
1117	22	267	60% gelatin	0.22			-1.45			0.95		No crater					
1118	22	213	80% gelatin	0.22			-1.46			0.30							
1119	23	34	Atlas 60	0.94			-2.38		2.72	4.39			31.70				
1120	23	44	Atlas 60	1.92			-3.01		3.31	4.99			30.19				
1121	22	232	80% gelatin	0.21			-1.44		1.71	0.80			0.75				
1122	22	54	Gelodyn 1	0.063			-0.98			No crater							
1123	22	126	60% gelatin	0.066			-0.98				Crater						
1124	22	141	60% gelatin	0.066			-0.98		1.21	1.22			2.25				
1125	22	216	80% gelatin	0.20			-1.42		0.33	0.75							
1126	22	231	80% gelatin	7.66			-4.83			7.53			400.0‡				
1127	22	45	60% gelatin	0.059			-0.96			No crater							
1128	22	233	80% gelatin	0.21			-1.45		0.04	0.46			0.0				
1129	22	234	80% gelatin	0.21			-1.45		0.42	1.65			1.14				
1130	22	190	80% gelatin	0.055			-0.94			Crater 2 in. deep							
1131	22	191	80% gelatin	0.055			-0.94			Collar circle 1 in. deep							
1132	22	113	60% gelatin	0.063			-0.99		0.25	0.90			0.12				
1133	22	114	60% gelatin	0.066			-0.99		1.21	0.82			1.23				
1134	22	131	60% gelatin	0.194			-1.44			No crater							
1135	22	104	60% gelatin	0.059			-0.97			No crater							
1136	22	106	60% gelatin	0.059			-0.97			No crater							
1137	23	71	Military C-3	1.99			-3.15		3.26	4.36			48.99				
1138	22	105	60% gelatin	0.059			-0.98			No crater							
1139	22	229	80% gelatin	3.02			-3.62		4.58	4.55			88.50				
1140	22	146	60% gelatin	0.192			-1.46		2.67	1.75			3.41				
1141	22	217	80% gelatin	0.20			-1.46		0.25	0.54							

‡ Estimated.

Table 3 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
1142	22	218	80% gelatin	0.20			-1.46		0.33	0.96							
1143	22	219	80% gelatin	0.20			-1.46		0.08	0.30							
1144	22	221	80% gelatin	0.20			-1.46		0.83‡	1.32‡			5.80‡				
1145	23	20	Atlas 60	1.92			-3.12		0.76	3.09			2.07				
1146	22	152	60% gelatin	0.450			-1.95		0.00	0.00							
1147	22	188	80% gelatin	0.050			-0.94		Collar circle 1/2 in. deep								
1148	22	189	80% gelatin	0.050			-0.94		Collar circle 1/2 in. deep								
1149	23	92	Military C-3	0.50			-2.01		2.45	0.86			1.02				
1150	23	99	Military C-3	1.00			-2.54		3.08	1.58			1.40				
1151	52	71	Pentolite	2.65			-3.5		2.1	4.7			25.0				
1152	52	72	Pentolite	2.65			-3.5		3.7	5.8			62.9				
1153	52	73	Pentolite	2.65			-3.5		3.5	4.1			33.6				
1154	52	74	Pentolite	2.65			-3.5		4.0	6.5			96.2				
1155	52	75	Pentolite	2.65			-3.5		3.8	4.9			47.7				
1156	52	76	Pentolite	2.65			-3.5			No crater							
1157	52	77	Pentolite	2.65			-3.5			No crater							
1158	52	78	Pentolite	2.65			-3.5			No crater							
1159	52	79	Pentolite	2.65			-3.5			No crater							
1160	52	80	Pentolite	2.65			-3.5			No crater							
1161	52	81	Pentolite	2.65			-3.5		1.2	4.0			16.0				
1162	52	82	Pentolite	2.65			-3.5			No crater							
1163	52	83	Pentolite	2.65			-3.5			No crater							
1164	52	84	Pentolite	2.65			-3.5			No crater							
1165	52	85	Pentolite	2.65			-3.5			No crater							
1166	52	111	Military C-3	2.65			-3.5			No crater							
1167	22	230	80% gelatin	5.28			-4.42			7.20			350.0‡				
1168	22	220	80% gelatin	0.20			-1.48		0.25	0.76							
1169	22	149	60% gelatin	0.306			-1.71		2.83	1.10			2.94				

‡ Estimated.

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
1170	22	226	80% gelatin	0.45			-1.96		0.12	0.44							
1171	22	227	80% gelatin	0.45			-1.96			1.70							
1172	22	143	60% gelatin	0.111			-1.23		1.58	0.50			0.41				
1173	22	228	80% gelatin	1.48			-2.94		4.12	2.48			24.0				
1174	22	125	60% gelatin	0.052			-0.96				Crater						
1175	22	137	60% gelatin	0.448			-1.97				No crater						
1176	22	225	80% gelatin	0.45			-2.00		2.08	2.81			20.10				
1177	22	29	60% gelatin	0.029			-0.81		0.27	0.61			0.12				
1178	22	30	60% gelatin	0.029			-0.81		0.04	0.25			0.00				
1179	22	31	60% gelatin	0.029			-0.81		0.23	0.41			0.03				
1180	22	186	80% gelatin	0.045			-0.94		Collar circle 1/2 in. deep								
1181	23	61	Atlas 60	19.09			-7.00		8.60								
1182	22	128	60% gelatin	0.109			-1.26				No crater						
1183	22	187	80% gelatin	0.045			-0.95		Collar circle 1/2 in. deep								
1184	22	140	60% gelatin	0.051			-0.98		0.38	0.88			0.57				
1185	23	45	Atlas 60	1.92			-3.29		1.89	2.03			1.80				
1186	23	114	Military C-3	19.98			-7.20										
1187	23	53	Atlas 60	4.80			-4.52										
1188	23	80	Military C-3	4.92			-4.54		1.28	3.03			10.78				
1189	23	27	Atlas 60	0.48			-2.09			2.45							
1190	23	35	Atlas 60	0.94			-2.63			0.38							
1191	23	100	Military C-3	1.00			-2.79		3.38	0.65			0.31				
1192	23	72	Military C-3	1.99			-3.53			0.81							
1193	23	93	Military C-3	0.50			-2.24		2.50	0.80			0.47				
1194	23	101	Military C-3	1.00			-2.85		3.43	1.76			3.06				
1195	23	21	Atlas 60	1.93			-3.61										
1196	52	86	Pentolite	2.65			-4.0				No crater						
1197	52	87	Pentolite	2.65			-4.0				No crater						

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB–TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
1198	52	83	Pentolite	2.65			-4.00			No	crater						
1199	52	89	Pentolite	2.65			-4.00			No	crater						
1200	52	90	Pentolite	2.65			-4.00			No	crater						
1201	52	91	Pentolite	2.65			-4.00			No	crater						
1202	52	92	Pentolite	2.65			-4.00		2.8	5.0			55.0				
1203	52	93	Pentolite	2.65			-4.00		1.7	3.1			16.1				
1204	52	94	Pentolite	2.65			-4.00			No	crater						
1205	52	95	Pentolite	2.65			-4.00			No	crater						
1206	52	96	Pentolite	2.65			-4.00			No	crater						
1207	52	97	Pentolite	2.65			-4.0			No	crater						
1208	52	98	Pentolite	2.65			-4.0			No	crater						
1209	52	112	Military C-3	2.65			-4.0		0.8	4.1			6.0				
1210	22	64	Coalite 7-S	0.035			-0.99			No	crater						
1211	22	46	60% gelatin	0.030			-0.98			No	crater						
1212	22	55	Gelodyn 1	0.028			-0.98			No	crater						
1213	23	102	Military C-3	1.00			-3.34			0.72							
1214	22	155	Coalite 7-S	0.014			-0.96		1.21	0.52			0.07				

Table 4

Results of Crater Measurements in Rock

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
						Shots Fired in Basalt											
1215	46	14	TNT	25	25	2.92	0.0	0.0	0.73	2.02	0.17		5.7	1.57	3.06		21.9
1216	46	15(1A)	TNT	200	200	5.85	0.0	0.0	1.6	4.65			49.4	3.3	7.15		275
1217	46	16(2A)	TNT	200	200	5.85	0.0	0.0	1.2	5.3			62.9	2.6	7.15		201
1218	46	17(3A)	TNT	200	200	5.85	-1.2	-0.21	1.3	5.55			43.2	3.2	7.95		363.2
1219	46	18(4A)	TNT	200	200	5.85	-1.2	-0.21	1.1	3.7			30.0	4.0	7.5		379.4
1220	46	13	TNT	25	25	2.92	-1.5	-0.51	3.05	4.59	0.29		85.6	3.39	6.02		164
1221	46	2	TNT	75	75	4.22	-4.0	-0.95	0.70	3.49	0.39		34.6	5.20	9.92		972.0
1222	46	9	TNT	25	25	2.92	-3.0	-1.03	1.20	2.38	0.27		11.3	4.90	5.30		125.6
1223	46	3	TNT	75	75	4.22	-6.0	-1.42	3.43	6.92	0.41		21.1	7.50	13.78		1165
1224	46	1	TNT	8	8	2	-3.0	-1.50	1.08	3.20	0.30		35.4	3.80	8.50		345.1
1225	46	6	TNT	25	25	2.92	-4.5	-1.54	0.85	2.92	0.50		16.7	5.40	7.48		275.9
1226	46	4	TNT	25	25	2.92	-6.0	-2.05	2.90	6.64	0.09		98.8	7.30	7.44		370.7
1227	46	12	TNT	200	200	5.85	-12.0	-2.05	3.98	9.52	1.29		547.0		Not excavated		
1228	46	5	TNT	25	25	2.92	-7.5	-2.57	0.0	0.0	0.76		0.0	8.50	9.45		637.5
1229	46	11	TNT	75	75	4.22	-12.5	-2.96	0.0	----	0.78		-----		Not excavated		
1230	46	7	TNT	25	25	2.92	-9.0	-3.08	2.30	3.52	0.40		14.3	9.5	5.70		158
1231	46	8	TNT	8	8	2	-7.0	-3.50	1.05	2.35	0.50		15.1	7.70	5.58		213
1232	46	10	TNT	25	25	2.92	-10.5	-3.60	0.63	1.89	0.32		1.6	11.20	5.72		156
						Shots Fired in Chalk											
1233	8		Ammonia gelatin	8.0			-0.8							2.5	5.4		96
1234	8		Ammonia gelatin	8.0			-1.9							3.3	5.5		272
1235	8		Semigelatin Type A	2.0			-1.4							1.3	3.4		18
1236	8		Ammonia gelatin	8.0			-3.7							4.9	6.5		312
1237	8		Semigelatin Type A	2.0			-2.5							2.7	4.2		70
1238	8		Semigelatin Type A	8.0			-4.7							5.1	7.6		400
1239	8		Semigelatin Type A	4.5			-4.7							5.0	6.6		261
1240	8		Ammonia gelatin	8.0			-6.2							7.5	7.5		448

* Numbers correspond to Bibliography numbers.

Table 4 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Chalk (Continued)														
1241	8		Semigelatin Type A	2.0			-4.4							0.9	4.0		20
1242	8		Ammonia gelatin	1.5			-1.0**							1.6	3.1		37
1243	8		Semigelatin Type A	2.0			-1.7							Just broke surface			
1244	8		Ammonia gelatin	3.0			-5.8**							2.3	4.8		99
1245	8		Semigelatin Type A	0.9			-4.7								No crater		
1246	8		Semigelatin Type A	2.0			-6.2								No crater		
1247	8		Ammonia Gelatin	8.0			-10.7								No crater		
1248	8		Ammonia Gelatin	0.8			-5.0**							-0.9	2.4		9
1249	8		Ammonia Gelatin	0.4			-5.2**								No crater		
			Shots Fired in Granite														
1250	13	601	TNT	320	320	6.84	2.5	0.36		1.2							
1251	13	602	TNT	320	320	6.84	0.0	0.0						1.7	8.43		165
1252	4	II D-2	C-2	2560			-4.17							5.95	22.68		3,199.04
1253	4	II D-1	TNT	1080	1080	10.2	-3.31	-0.33						6.8	16.7		1,989.06
1254	13	603	TNT	320	320	6.84	-2.5	-0.36						2.6	9.70		330
1255	13	607	TNT	320	320	6.84	-2.5	-0.36						5.3	14.4		2,580
1256	13	608	TNT	320	320	6.84	-2.5	-0.36						4.6	14.0		1,540
1257	13	611	TNT	320	320	6.84	-2.5	-0.36						5.0	13.4		1,095
1258	13	609	TNT	2560	2560	13.68	-5.0	-0.36						10.2	25.2		10,300
1259	13	610	TNT	2560	2560	13.68	-5.0	-0.36						8.7	23.1		8,480
1260	8		Semigelatin Type A	6.2			-0.7							1.1	4.2		16.7
1261	8		Semigelatin Type B	4.5			-0.9							1.1	4.1		14.0
1262	4	II C-2	C-2	320			-4.17							5.87	13.98		1,200.76
1263	13	604	TNT	320	320	6.84	-5.0	-0.73						5.0	14.5		1,030
1264	4	II C-1	TNT	70.50	70.50	4.13	-3.40	-0.82						2.38	8.13		164.65
1265	4	B-15A	TNT	100	100	4.64	-3.92	-0.84						4.10	6.41		177.24
1266	4	A-8	TNT	2.62	2.62	1.38	-1.28	-0.93						0.75	2.56		5.27

** Charge hole drilled horizontally.

Table 4 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Granite (Continued)														
1267	8		Semigelatin Type A	6.2			-1.8							1.4	5.2		40.0
1268	4	C-19	TNT	70.12	70.12	4.12	-4.12	-1.0						4.30	11.40		587.60
1269	4	A-20	C-2	0.80			-0.98							0.75	2.46		4.85
1270	4	C-16	TNT	14.12	14.12	2.42	-2.65	-1.09						2.20	4.16		40.08
1271	4	A-9	C-2	0.50			-1.90							0.35	1.76		1.17
1272	4	C-18	TNT	50.12	50.12	3.68	-4.08	-1.11						5.25	9.70		519.62
1273	4	C-1	C-2	10.0			-2.40							3.00	5.80		107.10
1274	4	B-22	C-2	250			-7.10							7.50	16.2		2,063.20
1275	4	A-19	C-2	0.50			-0.90							0.45	1.92		1.75
1276	4	C-20	C-2	100			-5.33							5.90	10.49		684.10
1277	8		Semigelatin Type B	4.5			-2.0							0.9	3.5		11.0
1278	4	A-7	TNT	1.62	1.62	1.17	-1.46	-1.24						1.30	2.50		8.66
1279	4	A-4	C-2	2.20			-1.63							1.00	2.86		8.73
1280	4	C-17	TNT	25.12	25.12	2.93	-3.66	-1.25						2.35	6.83		115.34
1281	4	B-10	C-2	30.0			-3.75							3.60	9.24		323.93
1282	4	A-42	C-2	18.0			-3.29							2.80	6.06		109.49
1283	4	B-14-A	C-2	75.0			-5.38							3.02	10.32		320.97
1284	4	A-21	C-2	0.31			-0.90							0.45	1.84		1.62
1285	4	A-14	C-2	4.50			-2.18							1.65	3.49		21.48
1286	4	B-21	C-2	215.0			-8.15							8.15	11.95		1,206.30
1287	4	A-36	C-2	8.50			-2.80							2.70	6.61		125.97
1288	4	A-41	TNT	10.13	10.13	2.16	-3.20	-1.47						1.45	4.50		31.30
1289	4	C-8	TNT	40.12	40.12	3.42	-5.06	-1.48						2.95	7.3		165.35
1290	4	B-3	C-2	20.0			-4.04							3.05	5.35		93.93
1291	4	C-7	C-2	45.0			-5.34							2.85	7.52		169.49
1292	4	A-17	TNT	1.12	1.12	1.04	-1.60	-1.54						0.80	5.10		22.17
1293	4	A-32-A	C-2	4.50			-2.59							2.25	6.19		92.01

Table 4 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Granite (Continued)														
1294	4	A-35	C-2	7.00			-3.00							1.85	4.82		45.73
1295	4	A-18	C-2	0.20			-0.94							0.20	1.64		0.57
1296	4	A-10	TNT	1.12	1.12	1.04	-1.68	-1.62						0.50	1.73		1.60
1297	8		Semigelatin Type A	6.2			-3.0							1.1	5.8		33.0
1298	4	C-2	C-2	10.0			-3.55							1.70	6.34		71.88
1299	4	B-13	C-2	60.0			-6.50							4.00	8.63		313.48
1300	4	C-9	TNT	25.12	25.12	3.93	-5.01	-1.71						3.65	6.71		173.16
1301	4	A-13	C-2	2.60			-2.42							0.50	1.02		0.55
1302	8		Semigelatin Type B	4.1			-2.8							1.1	5.8		38.1
1303	4	B-5	C-2	15.0			-4.39							2.05	4.59		45.93
1304	8		Gelatin Type B	1.2			-1.9							0.8	4.4		13.2
1305	8		Semigelatin Type B	1.2			-1.9							0.9	3.6		9.4
1306	8		Semigelatin Type B	19.0			-4.8							1.6	6.2		64.6
1307	8		Gelatin Type B	4.1			-2.9							1.2	4.3		20.1
1308	4	A-3	C-2	1.00			-1.83							1.00	4.10		17.38
1309	13	605	TNT	320	320	6.84	-12.5	-1.83						6.1	17.1		2,320
1310	8		Semigelatin Type B	9.6			-3.9							1.6	4.8		34.6
1311	8		Semigelatin Type B	32.0			-5.9							2.0	9.0		125.0
1312	8		Gelatin Type B	19.0			-5.1							1.6	11.6		186.0
1313	8		Gelatin Type B	9.6			-4.1							1.1	7.0		53.8
1314	4	A-37	C-2	5.00			-3.34							1.25	3.54		16.25
1315	4	A-11-A	C-2	1.50			-2.25							1.05	2.83		8.96
1316	8		Semigelatin Type B	4.3			-3.2							0.5	2.6		3.8
1317	4	B-16	C-2	39.0			-6.80							3.55	8.40		263.44
1318	4	A-29	TNT	3.13	3.13	1.46	-3.04	-2.08						2.00	5.84		72.59
1319	4	A-34-A	TNT	3.13	3.13	1.46	-3.04	-2.08						1.65	6.54		75.18
1320	4	C-3	C-2	10.0			-4.50							2.50	6.27		103.55

Table 4 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Slots Fired in Granite (Continued)												
1321	4	A-6	TNT	0.62	~~0.62~~	0.85	-1.82	-2.13						0.95	2.77		7.78
1322	4	A-40	TNT	5.13	5.13	1.72	-3.79	-2.20						0.75	4.64		17.17
1323	8		Semigelatin Type A	6.2			-4.2							0.6	3.4		6.2
1324	4	A-38	C-2	3.75			-3.56							2.75	5.39		85.29
1325	4	A-33	C-2	3.00			-3.37							1.25	3.17		13.37
1326	4	B-2	TNT	7.12	7.12	1.92	-4.50	-2.34						1.20	1.63		3.40
1327	4	A-1	C-2	0.40			-1.75							0.25	0.60		0.09
1328	4	B-17	C-2	23.81			-6.80							2.90	7.74		182.76
1329	8		Semigelatin Type B	4.3			-5.5							No crater			
1330	4	B-19-A	C-2	20.0			-6.52							1.80	6.08		70.07
1331	13	612	TNT	320	320	6.84	-17.0	-2.49						7.6	13.2		2,090
1332	4	C-4	C-2	10.0			-5.52							1.25	3.77		18.70
1333	4	B-6	C-2	7.00			-4.96							1.70	4.60		38.39
1334	4	A-12	C-2	1.10			-2.69							0.10	0.17		0.00
1335	4	A-39	TNT	2.63	2.63	1.38	-3.73	-2.70						0.45	3.48		5.80
1336	8		Semigelatin Type B	4.3			-4.5							Just broke surface			
1337	4	A-5	C-2	0.30			-1.87							0.25	0.95		0.24
1338	4	C-13A	C-2	95.0			-12.90							Hole caught fire			
1339	4	B-20	C-2	15.0			-7.08							1.60	6.74		76.38
1340	8		Semigelatin Type A	6.2			-5.3							0.5	2.3		2.7
1341	4	B-12	TNT	15.12	15.12	2.47	-7.17	-2.90						0.90	3.84		13.93
1342	4	A-30	C-2	2.00			-3.70							0.50	2.13		2.69
1343	4	C-5	C-2	10.0			-6.52							0.82	3.63		11.13
1344	4	B-8	C-2	5.30			-5.33							0.95	2.66		7.10
1345	4	B-18	C-2	11.38			-6.90							1.25	4.40		25.48
1346	4	B-4	C-2	4.00			-5.14							1.40	5.35		42.80
1347	4	C-12	C-2	70.0			-13.50							1.50	2.68		11.28

Table 4 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired in Granite (Continued)												
1348	4	B-9	C-2	3.25			-4.90							1.40	5.45		43.76
1349	4	A-16	C-2	0.46			-2.61							Slight surface cracking			
1350	4	A-32	TNT	1.12	1.12	1.04	-3.54	-3.41						0.25	0.20		0.01
1351	4	C-10	C-2	10.0			-7.46							Broke weak surface joint			
1352	4	A-2	C-2	0.15			-1.85								No crater		
1353	4	C-6	C-2	10.0			-7.70								No crater		
1354	4	B-7	C-2	2.50			-4.95							0.80	2.77		6.53
1355	13	606	TNT	320	320	6.84	-25.0	-3.65						2.0	5.20		857
1356	4	B-14	C-2	7.50			-7.25							0.55	2.55		3.74
1357	4	B-19	C-2	6.50			-6.94										
1358	4	A-11	C-2	0.45			-2.88								No crater		
1359	4	C-14	TNT	50.12	50.12	3.68	-13.79	-3.75						1.65	2.35		9.59
1360	4	C-11	C-2	25.0			-11.29								No crater		
1361	4	A-31	C-2	1.00			-3.92							0.10	0.59		0.02
1362	4	C-15	TNT	30.12	30.12	3.11	-12.38	-3.98							No crater		
1363	4	B-1	TNT	2.13	2.13	1.29	-5.20	-4.04						0.20	0.24		0.01
1364	4	B-15	C-2	5.50			-7.20								No crater		
1365	4	B-11	TNT	4.63	4.63	1.67	-6.83	-4.10						0.35	2.33		2.02
1366	4	C-13	C-2	40.00			-14.29								No crater		
1367	4	A-34	TNT	0.63	0.63	0.86	-3.82	-4.45							No crater		
1368	4	NX-1-C	C-2	26.20			-18.21							0.40	1.12		0.53
					Shots Fired in Limestone												
1369	13	502	TNT	320	320	6.84	-2.5	-0.36						3.9	8.3		414
1370	13	501	TNT	320	320	6.84	-6.6	-0.96						9.1	11.2		2,560
					Shots Fired in Marlstone												
1371	8		Semigelatin Type A	3.4			-1.2							1.2	3.1		15.0
1372	8		Semigelatin Type A	3.4			-2.4							2.6	3.3		32.0

Table 4 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	CRATER DIMENSIONS, TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
			Shots Fired in Marlstone (Continued)														
1373	8		Semigelatin Type A	13.5			-4.1							4.0	6.2		182.0
1374	8		Semigelatin Type A	7.6			-4.5							4.4	6.0		182.0
1375	8		Semigelatin Type A	3.4			-4.2							2.5	4.2		54.0
1376	8		Semigelatin Type A	3.4			-4.5							0.3	0.3		0.2
1377	8		Semigelatin Type A	3.4			-6.0							0.4	0.6		0.2
1378	8		Semigelatin Type A	1.5			-4.7								No crater		
			Shots Fired in Sandstone														
1379	48	16	TNT	25	25	2.92	0.0	0.0	0.85	3.44	0.08		19.2	1.09	3.82		31.3
1380	14	802	TNT	320	320	6.84	0.0	0.0						2.3	5.6		162
1381	8		Ammonia dynamite	8.0			-0.4							1.2	3.4		33
1382	8		Ammonia dynamite	8.0			-0.4							1.1	2.5		10
1383	8		Semigelatin Type A	8.0			-0.4							1.3	3.0		16
1384	8		Semigelatin Type A	8.0			-0.4							1.1	2.7		9
1385	8		Ammonia gelatin	8.0			-0.5							1.1	2.4		6
1386	4	D-2	C-2	2,560			-4.71							9.00	23.37		5,148
1387	4	D-1	C-2	1,080			-3.60							8.42	13.11		1,518
1388	14	801	TNT	320	320	6.84	-2.5	-0.36							No crater		
1389	14	803	TNT	320	320	6.84	-2.5	-0.36						4.8	11.6		810
1390	14	807	TNT	320	320	6.84	-2.5	-0.36						5.1	14.3		1,460
1391	14	808	TNT	320	320	6.84	-2.5	-0.36						5.8	13.1		1,020
1392	14	818	TNT	320	320	6.84	-2.5	-0.36						6.0	17.5		1,820
1393	14	819	TNT	320	320	6.84	-2.5	-0.36						6.5	15.6		1,440
1394	14	809	TNT	1,080	1,080	10.26	-3.75	-0.36						8.6	19.0		3,530
1395	14	810	TNT	2,560	2,560	13.68	-5.0	-0.36						9.7	32.6		8,650
1396	14	811	TNT	2,560	2,560	13.68	-5.0	-0.36						10.5	25.1		7,050
1397	14	812	TNT	2,560	2,560	13.68	-5.0	-0.36						11.0	23.3		6,880
1398	14	813	TNT	10,000	10,000	21.54	-7.9	-0.36						16.1	39.4		22,000

Table 4 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Sandstone (Continued)														
1399	14	814	TNT	40,000	40,000	34.2	-12.5	-0.36						26.9	56.5		108,000
1400	14	815	TNT	40,000	40,000	34.2	-12.5	-0.36						26.9	70.5		125,000
1401	14	816	TNT	40,000	40,000	34.2	-12.5	-0.36						27.5	53.6		106,000
1402	14	817	TNT	320,000	320,000	68.4	-25.0	-0.36						47.0	94.8		512,000
1403	4	C-2	TNT	320	320	68.4	-2.96	-0.43						7.10	11.92		1,057
1404	8		Ammonia dynamite	8.0			-0.9							1.6	3.0		18
1405	8		Ammonia dynamite	8.0			-0.9							1.2	2.6		16
1406	8		Semigelatin Type A	8.0			-0.9							1.6	3.5		36
1407	8		Semigelatin Type A	8.0			-0.9							1.7	3.3		31
1408	8		Ammonia gelatin	8.0			-1.0							1.3	3.5		17
1409	48	11	TNT	8	8	2	-1.0	-0.5	1.28	3.46	0.07		24.8	1.75	4.99		73.2
1410	48	9	TNT	25	25	2.92	-1.5	-0.51	2.23	5.14	0.19		88.3	2.70	5.55		140
1411	47	1	TNT	25	25	2.92	-1.5	-0.51	2.20	6.00	0.56		127	3.88	6.75		237
1412	14	804	TNT	320	320	6.84	-5.0	-0.73						7.6	14.0		1,440
1413	4	B-14	TNT	104.00	104.00	4.70	-3.50	-0.74						5.65	11.54		788.37
1414	4	A-16	C-2	2.00			-1.04							0.82	2.46		5.19
1415	4	A-12	C-2	2.25			-1.12							1.10	3.58		14.78
1416	8		Gelatin Type A	8.0			-1.8							2.7	6.1		120
1417	8		Semigelatin Type A	8.0			-1.8							2.5	4.0		63
1418	4	C-1	TNT	70	70	4.12	-3.84	-0.93						5.91	8.85		485.15
1419	48	6	TNT	75	75	4.22	-4.0	-0.95	4.48	8.42	0.45		428.8	9.35	11.88		2,234
1420	48	14	TNT	25	25	2.92	-3.0	-1.03	1.30	4.92	0.20		45.6	4.69	6.48		342.4
1421	4	A-42	C-2	10.0			-2.38							1.60	4.80		38.61
1422	4	A-14	C-2	1.62			-1.34							1.40	2.57		9.71
1423	4	C-1	C-2	10.0			-2.50							2.48	5.11		68.38
1424	4	A-29	C-2	9.5			-2.50							1.98	3.99		33.00
1425	8		Semigelatin Type A	8.0			-2.4							3.0	5.8		1.30

Table 4 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Sandstone (Continued)														
1426	8		Semigelatin Type A	8.0			-2.4							3.5	5.5		100
1427	4	A-17	C-2	4.25			-2.00							1.50	3.18		15.94
1428	4	A-13	C-2	4.25			-2.00							2.15	4.64		48.58
1429	8		Ammonia gelatin	8.0			-2.5							2.9	6.2		116
1430	8		Gelatin Type A	8.0			-2.5							3.2	5.5		140
1431	4	A-39	C-2	9.00			-2.70							2.50	4.87		62.16
1432	4	A-4	C-2	1.50			-1.51							2.88	2.84		12.25
1433	8		Gelatin Type A	8.0			-2.7							3.2	5.7		140
1434	4	A-8	C-2	.125			-1.48							1.10	2.85		9.38
1435	8		Gelatin Type A	8.0			-2.9							3.3	5.4		130
1436	8		Semigelatin Type A	8.0			-2.9							3.4	5.9		150
1437	48	2	TNT	8	8	2	-3.0	-1.5	1.73	3.85	0.23		39.7	5.00	6.47		383.7
1438	48	13	TNT	25	25	2.92	-4.5	-1.54	1.40	2.97	0.33		60.5	5.67	7.91		592.9
1439	4	B-8	C-2	18.38			-4.14							3.80	10.11		407.07
1440	4	A-36	C-2	6.00			-2.90							2.57	5.76		89.16
1441	4	A-24	C-2	3.00			-2.32							1.40	5.04		37.26
1442	4	C-2	C-2	10.0			-3.50							3.17	6.05		12[illegible].54
1443	4	C-2A	C-2	10.0			-3.50							4.57	5.70		155.16
1444	4	B-NX3	C-2	10.0			-3.50							2.32	5.15		64.41
1445	4	A-37	TNT	4.62	4.62	1.67	-2.75	-1.65						1.90	4.00		31.79
1446	4	A-34	C-2	6.00			-3.15							2.30	6.15		91.18
1447	4	B-10	C-2	14.00			-4.30							3.45	8.92		226.50
1448	4	A-35	TNT	4.12	4.12	1.60	-2.87	-1.79						2.32	4.05		39.00
1449	14	805	TNT	320	320	6.84	-12.5	-1.82						14.9	9.3		1,190
1450	4	B-19	TNT	38.12	38.12	3.36	-6.20	-1.84						5.40	6.41		232.06
1451	8		Gelatin Type A	8.0			-3.9							0.7	6.0		100
1452	8		Semigelatin Type A	8.0			-3.9							0.9	7.4		100

Table 4 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	CRATER DIMENSIONS, TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
					Shots Fired in Sandstone (Continued)												
1453	4	B-5	TNT	8.38	8.38	2.03	-4.00	-1.97						2.80	9.27		251.81
1454	4	C-6	C-2	21.0			-5.45							2.28	6.25		93.27
1455	48	10	TNT	200	200	5.85	-11.6	-1.98	1.20	4.96	0.50		189	13.84	16.27		6,001.3
1456	4	A-1	C-2	0.50			-1.58							0.38	0.84		0.28
1457	48	12	TNT	25	25	2.92	-6.0	-2.05	1.38	4.64	0.27		78.3	7.40	10.55		1,487
1458	4	A-48	TNT	6.62	6.62	1.88	-3.90	-2.07						2.25	3.04		21.81
1459	4	C-3	C-2	10.0			-4.50							1.77	5.98		66.43
1460	4	A-22	C-2	1.50			-2.41							1.20	3.22		13.02
1461	4	A-20	C-2	1.56			-2.38							1.20	3.48		15.20
1462	4	A-44	TNT	0.65	0.65	0.87	-1.84	-2.12						0.68	2.00		2.86
1463	4	A-45	TNT	1.42	1.42	1.12	-2.46	-2.19						0.60	1.47		1.35
1464	4	A-43	C-2	0.65			-1.92							0.35	1.39		0.73
1465	4	A-40	TNT	2.75	2.75	1.40	-3.21	-2.29						1.00	3.26		11.13
1466	4	C-9	TNT	12.12	12.12	2.30	-5.31	-2.31						1.85	5.97		69.11
1467	8		Semigelatin Type A	8.0			-4.7							2.3	8.0		150
1468	4	A-19	C-2	1.20			-2.50							1.05	2.38		6.22
1469	4	A-30	C-2	3.28			-3.50							1.25	2.68		9.46
1470	4	A-21	C-2	1.40			-2.66							0.90	2.62		6.50
1471	4	A-32	C-2	3.00			-3.53							1.18	3.05		11.51
1472	8		Gelatin Type A	8.0			-4.9							Just broke surface			
1473	4	A-47	C-2	6.50			-4.60							1.42	4.09		24.91
1474	4	B-17	TNT	17.62	17.62	2.60	-6.42	-2.47						2.35	8.49		177.21
1475	4	B-18	TNT	12.75	12.75	2.32	-5.75	-2.48						2.45	5.24		70.37
1476	4	A-50	TNT	4.62	4.62	1.67	-4.15	-2.49						0.70	2.46		4.46
1477	48	3	TNT	8	8	2	-5.0	-2.5	0.89	4.24	0.41		24.0	5.63	7.95		631.5
1478	47	3	TNT	8	8	2	-5.0	-2.5	1.58	4.82	0.56		55.6	6.55	6.61		407.46
1479	4	A-33	C-2	2.80			-3.55							1.03	3.22		11.18

Table 4 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired in Sandstone (Continued)												
1480	4	A-13	C-2	0.38			-1.84							0.50	1.80		1.71
1481	4	C-4	C-2	10.0			-5.50							1.90	4.82		46.28
1482	48	1	TNT	25	25	2.92	-7.5	-2.57	0.40	1.07	0.43		9.45	9.15	11.54		2,327
1483	4	B-1	C-2	6.00			-4.75							2.00	3.46		25.12
1484	4	A-49	C-2	4.50			-4.85							0.68	1.12		0.89
1485	48	4	TNT	75	75	4.22	-12.0	-2.84	1.00	0.54	1.26		0.81	12.80	16.34		5,905.7
1486	4	C-7	TNT	8.12	8.12	2.01	-5.80	-2.88						0.80	1.88		2.98
1487	4	C-13	C-2	70.00			-12.27							5.72	13.02		1,015.74
1488	4	B-16	TNT	10.62	10.62	2.19	-6.62	-3.02						2.28	3.69		32.59
1489	4	B-20	C-2	12.00			-6.91							2.20	5.23		63.00
1490	4	C-5	C-2	10.0			-6.56								No crater		
1491	48	7	TNT	25	25	2.92	-9.0	-3.08	0.0	0.0	0.83		0.0	10.70	13.19		3,076.1
1492	4	B-11	C-2	11.0			-6.85							0.65	2.04		2.84
1493	8		Ammonia gelatin	8.0			-6.6							0.8	2.0		4
1494	4	C-10	C-2	6.00			-6.17							0.80	2.01		3.37
1495	8		Gelatin Type A	8.0			-6.8								Just broke surface		
1496	8		Semigelatin Type A	8.0			-6.8								Just broke surface		
1497	8		Gelatin Type A	8.0			-6.9								No crater		
1498	8		Semigelatin Type A	8.0			-6.9								Just broke surface		
1499	48	5	TNT	8	8	2	-7.0	-3.5	0.0	0.0	0.23		0.0	8.60	3.12		35.4
1500	4	B-15	TNT	6.75	6.75	1.89	-6.75	-3.57							No crater		
1501	48	8	TNT	25	25	2.92	-10.5	-3.60	0.0	0.0	0.37		0.0	11.98	9.52		1,209
1502	14	806	TNT	320	320	6.84	-25.0	-3.64							No crater		
1503	4	C-11	TNT	33.62	33.62	3.23	-11.95	-3.70						0.75	2.61		5.34
1504	4	C-14	C-2	35.0			-12.62							1.65	1.92		6.38
1505	8		Semigelatin Type A	8.0			-9.8								No crater		
1506	8		Gelatin Type A	8.0			-9.9								No crater		

Table 4 (Concluded)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired in Sandstone (Continued)												
1507	8		Gelatin Type A	8.0			-9.9								No crater		
1508	8		Semigelatin Type A	8.0			-9.9								No crater		
1509	8		Ammonia gelatin	8.0			-10.5								No crater		
						Shots Fired in Shale											
1510	47	4	TNT	25	25	2.92	0.0	0.0	1.50	4.28	0.48		37.8	2.10	5.72		39.6
1511	47	13	TNT	25	25	2.92	0.0	0.0	1.80	3.68	0.39		38.9	2.50	5.40		110
1512	47	14	TNT	50	50	3.68	0.0	0.0	3.1	7.5			236	3.5	8.8		375
1513	47	15	TNT	50	50	3.68	0.0	0.0	3.8	8.8				4.2	9.1		
1514	47	16	TNT	50	50	3.68	-0.6	-0.16	2.6	7.2			176	3.0	7.6		270
1515	47	7	TNT	8	8	2	-1.0	-0.5	1.85	4.00	0.28		47.0	3.17	5.05		143
1516	47	9	TNT	25	25	2.92	-1.5	-0.51	2.65	6.38	0.73		168	5.10	7.35		302
1517	47	4	TNT	8	8	2	-2.0	-1.0	2.00	5.12	0.25		82.9	3.88	5.38		157
1518	47	3	TNT	8	8	2	-3.0	-1.5	2.38	5.88	0.25		38.1	4.50	6.25		196
1519	47	2	TNT	25	25	2.92	-4.5	-1.54	4.55	9.82	0.69		570.5	7.88	9.86		949.3
1520	47	10	TNT	25	25	2.92	-4.5	-1.54	3.25	9.50	0.85		408	6.80	10.38		802
1521	47	2	TNT	8	8	2	-4.0	-2.0	2.55	6.18	0.40		138	5.40	7.60		373
1522	47	11	TNT	200	200	5.85	-12.0	-2.05	4.30	12.92	2.08		1,253	15.50	17.62		8,413
1523	47	6	TNT	8	8	2	-5.0	-2.5	1.70	5.00	0.63		76.1	6.15	6.32		332
1524	47	1	TNT	25	25	2.92	-7.5	-2.57	1.50	6.25	0.78		122	10.75	8.00		1,056
1525	47	12	TNT	75	75	4.22	-12.0	-2.84	2.35	9.95	1.58		481		13.00		
1526	47	8	TNT	8	8	2	-6.0	-3.0	2.85	6.10	0.73		182	5.65	7.78		497
1527	47	5	TNT	8	8	2	-7.0	-3.5	1.20	4.12	0.83		28.1	7.95	5.60		316

Table 5

Results of Crater Measurements in Ice

(1 of 4 sheets)

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
1528	51	170	C-4	5.0			0.0		0.23	3.51			37.54				
1529	51	170R	C-4	5.0			0.0		0.23	3.06			36.05				
1530	51	110	Atlas 60	10.0			0.0		1.60	4.29			63.61				
1531	51	22	C-4	20.0			-0.03		2.28	5.67			155.29				
1532	51	108	Atlas 60	5.0			-0.21		1.90	4.08			49.59				
1533	51	170 1/4	C-4	5.0			-0.23		0.46	4.22			54.53				
1534	51	23	C-4	20.0			-0.38		2.63	6.84			261.86				
1535	51	17	C-4	10.0			-0.32		1.63	5.56			109.52				
1536	51	107	Atlas 60	10.0			-0.35		1.90	5.44			91.96				
1537	51	30	Coalite 5-S	2.5			-0.23		0.95	2.73			18.14				
1538	51	60	Coalite 5-S	5.0			-0.32		1.35	4.17			64.35				
1539	51	46	Coalite 5-S	10.0			-0.44		1.85	4.47			66.04				
1540	51	52	Coalite 5-S	20.0			-0.54		2.20	5.25			149.76				
1541	51	80	Coalite 7-S	20.0			-0.55		1.90	5.08			124.95				
1542	51	40	Coalite 5-S	5.0			-0.38		1.00	3.37			41.81				
1543	51	79	Atlas 60	5.0			-0.40		1.45	----			82.02				
1544	51	65	Coalite 7-S	10.0			-0.49		3.00	4.90			141.78				
1545	51	170 1/2	C-4	5.0			-0.46		0.68	4.06			47.07				
1546	51	106	Atlas 60	10.0			-0.62		2.65	5.70			202.93				
1547	51	61	Coalite 5-S	5.0			-0.51		1.81	4.15			63.65				
1548	51	16	C-4	10.0			-0.65		2.95	7.15			271.68				
1549	51	151	C-4	20.0			-0.83		4.93	7.24			339.09				
1550	51	47	Coalite 5-S	10.0			-0.72		2.05	4.92			80.26				
1551	51	53	Coalite 5-S	20.0			-0.93		2.20	7.21			203.42				
1552	51	31	Coalite 5-S	2.5			-0.48		1.00	2.56			11.74				
1553	51	81	Coalite 7-S	20.0			-1.01		2.56	6.31			193.31				
1554	51	38	Coalite 5-S	2.5			-0.54		1.00	3.45			20.04				
1555	51	66	Coalite 7-S	10.0			-0.92		4.02	5.74			181.68				

* Numbers correspond to Bibliography numbers.

Table 5 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
1556	51	78	Atlas 60	5.0			-0.88		2.25	5.24			108.35				
1557	51	170 3/4	C-4	5.0			-0.92		1.15	4.70			81.81				
1558	51	113	Atlas 60	10.0			-1.20		2.15	5.45			143.34				
1559	51	152	C-4	20.0			-1.53		2.88	7.61			280.03				
1560	51	41	Coalite 5-S	5.0			-1.04		1.95	4.56			69.01				
1561	51	48	Coalite 5-S	10.0			-1.36		2.60	6.87			260.33				
1562	51	36	Coalite 5-S	2.5			-1.74		2.15	3.82			58.21				
1563	51	54	Coalite 5-S	20.0			-1.79		3.00	6.62			245.67				
1564	51	1	C-4	5.0			-1.20		2.0	4.97			114.15				
1565	51	10	C-4	10.0			-1.51		2.91	5.11			175.66				
1566	51	37	Coalite 5-S	2.5			-1.09		1.60	3.15			26.38				
1567	51	67	Coalite 7-S	10.0			-1.72		2.82	5.73			187.69				
1568	51	42	Coalite 5-S	5.0			-1.39		2.20	4.21			61.60				
1569	51	82	Coalite 7-S	20.0			-2.21		3.90	7.51			370.60				
1570	51	62	Coalite 5-S	5.0			-1.44		2.44	5.07			115.93				
1571	51	24	C-4	20.0			-2.37		3.92	8.51			470.66				
1572	51	32	Coalite 5-S	2.5			-1.27		1.65	3.31			30.11				
1573	51	171	C-4	5.0			-1.65		1.92	5.18			106.04				
1574	51	77	Atlas 60	5.0			-1.82		2.72	6.02			141.93				
1575	51	105	Atlas 60	10.0			-2.31		3.56	6.44			224.32				
1576	51	153	C-4	20.0			-2.94		4.74	7.52			396.19				
1577	51	25a	C-4	20.0			-2.92		4.62	9.67			517.05				
1578	51	2	C-4	5.0			-2.06		3.2	4.59			155.74				
1579	51	49	Coalite 5-S	10.0			-2.74		3.71	6.23			222.60				
1580	51	55	Coalite 5-S	20.0			-3.69		4.95	8.42			503.82				
1581	51	F 3	Atlas 60	2.5			-1.89		2.13	4.98			76.96				
1582	51	63	Coalite 5-S	5.0			-2.48		3.48	5.81			213.93				
1583	51	11	C-4	10.0			-3.17		4.47	6.95			381.29				

Table 5 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	CRATER DIMENSIONS APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	CRATER DIMENSIONS TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
1584	51	25B	C-4	20.0			-4.05		5.85	8.57			719.31				
1585	51	95	Atlas 60	20.0			-4.05		5.45	8.01			505.33				
1586	51	68	Coalite 5-S	10.0			-3.39		4.14	6.98			285.55				
1587	51	83	Coalite 7-S	20.0			-4.33		5.40	10.13			877.04				
1588	51	E	Atlas 60	2.5			-2.36		2.51	5.18			106.17				
1589	51	33	Coalite 5-S	2.5			-2.52		2.77	3.80			52.94				
1590	51	43	Coalite 5-S	5.0			-3.48		3.76	5.07			123.16				
1591	51	3	C-4	5.0			-3.73		4.93	5.00			157.86				
1592	51	76	Atlas 60	5.0			-3.80		4.70	6.57			276.96				
1593	51	26	C-4	20.0			-6.07		7.57	9.34			944.60				
1594	51	64	Coalite 5-S	5.0			-3.84		4.39	6.08			275.73				
1595	51	96-R	Atlas 60	20.0			-6.15		8.80	7.77			642.17				
1596	51	115	Atlas 60	10.0			-4.93		5.60	7.59			495.15				
1597	51	104	Atlas 60	40.0			-8.10		10.10	11.04			2181.70				
1598	51	12	C-4	10.0			-5.20		6.10	7.10			448.74				
1599	51	39	Coalite 5-S	2.5			-3.44		3.90	4.93			175.52				
1600	51	C	Atlas 60	2.5			-3.61		4.02	6.71			192.02				
1601	51	97	Atlas 60	20.0			-7.46		10.00	9.17			1180.15				
1602	51	120	Coalite 7-S	10.0			-6.00		7.18	10.07			1055.88				
1603	51	44	Coalite 5-S	5.0			-4.88		5.30	6.62			315.99				
1604	51	50	Coalite 5-S	10.0			-6.13		6.15	8.555			680.56				
1605	51	56	Coalite 5-S	20.0			-7.73		8.80	9.85			1144.02				
1606	51	84	Coalite 7-S	20.0			-7.80		8.90	9.89			1333.16				
1607	51	88	Coalite 7-S	2.5			-4.09		4.40	6.24			181.18				
1608	51	27	C-4	20.0			-8.18		9.66	9.26			1201.81				
1609	51	8	C-4	2.5			-4.20		4.85	5.90			240.95				
1610	51	6	C-4	5.0			-5.34		6.14	6.15			365.66				
1611	51	34	Coalite 5-S	2.5			-4.38		2.75	4.17			62.85				

Table 5 (Concluded)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
1612	51	155	C-4	40.0			-11.07		11.90	12.55			1620.99				
1613	51	69	Coalite 5-S	10.0			-7.01		8.36	6.37			192.90				
1614	51	99	Atlas 60	20.0			-8.95		9.50	12.21			1682.38				
1615	51	4	C-4	5.0			-5.66			6.38							
1616	51	13	C-4	10.0			-7.28		9.65	7.45			538.76				
1617	51	3	C-4	20.0			-9.33			10.36							
1618	51	A	Atlas 60	2.5			-4.74		5.05	6.15			165.96				
1619	51	102	Atlas 60	40.0			-12.16		12.10	13.51			1874.83				
1620	51	116	Atlas 60	10.0			-7.65		8.70	8.95			917.63				
1621	51	90	Coalite 7-S	5.0			-4.89		5.20	6.67			338.37				
1622	51	D	Atlas 60	2.5			-4.94		5.13								
1623	51	100	Atlas 60	20.0			-10.10		11.20	9.76			1944.29				
1624	51	74	Atlas 60	5.0			-6.69		7.50	8.36			534.64				
1625	51	14	C-4	10.0			-8.59			6.96							
1626	51	45	Coalite 5-S	5.0			-6.90										
1627	51	35	Coalite 5-S	2.5			-5.74										
1628	51	7	C-4	2.5			-5.97										
1629	51	98	Atlas 60	20.0			-12.01		4.85	9.81							
1630	51	86	Coalite 7-S	10.0			-9.74		10.80								
1631	51	B	Atlas 60	2.5			-6.20		6.39								
1632	51	72	Atlas 60	10.0			-9.92			9.74			700.22				
1633	51	29	C-4	20.0			-12.98										
1634	51	5	C-4	5.0			-8.22										
1635	51	156	C-4	40.0			-16.95										
1636	51	G	Atlas 60	2.5			-6.80		7.10	9.28							
1637	51	101	Atlas 60	20.0			-14.47										
1638	51	103	Atlas 60	40.0			-18.67										
1639	51	H	Atlas 60	2.5			-7.58		7.66	2.92			44.76				

Table 6

Results of Crater Measurements in Snow

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	EXPLOSIVE DATA: CHARGE WEIGHT LB	EXPLOSIVE DATA: W LB-TNT EQUIVALENT	EXPLOSIVE DATA: $W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	CHARGE POSITION: λ_c	APPARENT: d_a FT	APPARENT: r_a FT	APPARENT: h_a FT	APPARENT: α_a DEG	APPARENT: V_a CU FT	TRUE: d_t FT	TRUE: r_t FT	TRUE: α_t DEG	TRUE: V_t CU FT
1640	19	0-1	40% gelatin	0.452			0.00		1.00	1.96							
1641	19	01-5	TNT	0.50	0.50	0.794	0.00	0.00	1.42	3.00							
1642	19	02-5	TNT	0.50	0.50	0.794	0.00	0.00	1.75	2.67							
1643	19	0-2	40% gelatin	0.904			0.00		1.33	2.75							
1644	19	0-1	TNT	1.0	1.0	1.0	0.00	0.00	3.50	2.92							
1645	19	0-3	40% gelatin	1.356			0.00		1.75	2.67							
1646	19	0-15	TNT	1.5	1.5	1.145	0.00	0.00	1.92	2.79							
1647	19	0-4	40% gelatin	1.808			0.00		2.08	3.50							
1648	19	0-2	TNT	2.0	2.0	1.26	0.00	0.00	2.00	2.96							
1649	19	0-6	40% gelatin	2.712			0.00		1.92	3.29							
1650	38	1	TNT	8.0	8.0	2.0	-2.00	-1.00	3.60	5.80			166				
1651	38	2	TNT	8.0	8.0	2.0	-2.00	-1.00	3.50	6.70			224				
1652	38	3	TNT	8.0	8.0	2.0	-2.00	-1.00	3.40	5.50			185				
1653	19	20-6	40% gelatin	2.712			-1.67		2.83	4.46							
1654	19	20-4	40% gelatin	1.808			-1.67		2.83	4.33							
1655	19	20-15	TNT	1.5	1.5	1.145	-1.67	-1.45	2.25	4.00							
1656	19	20-3	40% gelatin	1.356			-1.67		2.33	4.16							
1657	19	25-21	TNT	2.0	2.0	1.26	-2.08	-1.65	2.25	4.25							
1658	19	25-22	TNT	2.0	2.0	1.26	-2.08	-1.65	2.08	3.96							
1659	19	20-2	40% gelatin	0.904			-1.67		1.83	3.62							
1660	19	21-1	TNT	1.0	1.0	1.0	-1.75	-1.75	1.75	3.25							
1661	19	25-11	TNT	1.0	1.0	1.0	-2.08	-2.08	1.83	2.96							
1662	19	25-12	TNT	1.0	1.0	1.0	-2.08	-2.08	1.92	3.29							
1663	19	25-13	TNT	1.0	1.0	1.0	-2.08	-2.08	2.00	3.12							
1664	19	20-05	TNT	0.5	0.5	0.794	-1.67	-2.10	1.17	2.83							
1665	19	20-1	40% gelatin	0.452			-1.67		1.08	2.92							
1666	19	40-6	40% gelatin	2.712			-3.33		1.58	4.50							
1667	19	40-4	40% gelatin	1.808			-3.33		1.50	3.58							

* Numbers correspond to Bibliography numbers.

Table 6 (Continued)

(2 of 3 sheets)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
1668	19	40-3	40% gelatin	1.356			-3.33		1.25	3.16							
1669	19	41-15	TNT	1.5	1.5	1.145	-3.42	-2.98	1.67	3.21							
1670	19	46-2	TNT	2.0	2.0	1.26	-3.84	-3.04	1.33	3.29							
1671	19	40-1	TNT	1.0	1.0	1.0	-3.33	-3.33	1.25	2.54							
1672	19	32-5	TNT	0.5	0.5	0.794	-2.67	-3.36	1.92	2.5							
1673	19	40-2	40% gelatin	0.904			-3.33		0.83	2.67							
1674	19	33-5	TNT	0.5	0.5	0.794	-2.75	-3.46	0.92	2.79							
1675	19	60-6	40% gelatin	2.712			-5.00		1.00	3.62							
1676	19	60-4	40% gelatin	1.808			-5.00		1.00	2.79							
1677	19	62-2	TNT	2.0	2.0	1.26	-5.17	-4.10	1.25	2.46							
1678	19	40-1	40% gelatin	0.452			-3.33		0.92	1.71							
1679	19	60-15	TNT	1.5	1.5	1.145	-5.00	-4.36	1.50	1.79							
1680	19	42-5	TNT	0.5	0.5	0.794	-3.50	-4.41	0.83	2.38							
1681	19	60-3	40% gelatin	1.356			-5.00		0.92	3.00							
1682	19	78-6	40% gelatin	2.712			-6.50		1.25	2.66							
1683	19	57-1	TNT	1.0	1.0	1.0	-4.75	-4.75	1.33	2.00							
1684	19	58-1	TNT	1.0	1.0	1.0	-4.83	-4.83	1.50	1.50							
1685	19	70-15	TNT	1.5	1.5	1.145	-5.83	-5.10	4.58	1.75							
1686	19	60-2	40% gelatin	0.904			-5.00		2.00	1.5							
1687	19	63-1	TNT	1.0	1.0	1.0	-5.25	-5.25		0.67							
1688	19	81-2	TNT	2.0	2.0	1.26	-6.75	-5.36	2.83	1.21							
1689	19	80-4	40% gelatin	1.808			-6.67		0.92	2.17							
1690	19	75-1	TNT	1.0	1.0	1.0	-5.67	-5.67		0.62							
1691	19	80-15	TNT	1.5	1.5	1.145	-6.67	-5.82		1.16							
1692	19	70-1	TNT	1.0	1.0	1.0	-5.83	-5.83		0.62							
1693	19	90-2	TNT	2.0	2.0	1.26	-7.50	-5.95	3.00	0.96							
1694	19	80-3	40% gelatin	1.356			-6.67		0.17	0.50							
1695	19	57-5	TNT	0.5	0.5	0.794	-4.75	-5.98		0.50							

Table 6 (Concluded) (3 of 3 sheets)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
[illegible]	19	102-6	40% gelatin	2.712			-8.50		0.58	1.42							
1697	19	58-5	TNT	0.5	0.5	0.794	-4.83	-6.09	3.92	0.46							
1698	19	58-1	40% gelatin	0.452			-4.83		0.17	0.17							
1699	19	89-15	TNT	1.5	1.5	1.145	-7.42	-6.48	2.92	1.08							
1700	19	100-2	TNT	2.0	2.0	1.26	-8.33	-6.61	3.92	1.00							
1701	19	63-5	TNT	0.5	0.5	0.794	-5.25	-6.62		0.58							
1702	19	100-4	40% gelatin	1.808			-8.33			0.71							
1703	19	80-2	40% gelatin	0.904			-6.67		0.17	0.33							
1704	19	94-3	40% gelatin	1.356			-7.83			0.63							
1705	19	85-1	TNT	1.0	1.0	1.0	-7.08	-7.08		0.54							
1706	19	72-5	TNT	0.5	0.5	0.794	-6.00	-7.56		0.46							
1707	19	92-2	40% gelatin	0.904			-7.67		2.08	0.58							
1708	19	80-1	40% gelatin	0.452			-6.67		0.00	0.00							
1709	19	85-5	TNT	0.5	0.5	0.794	-7.08	-8.94		0.46							

Table 7

Properties of Clays

	Area					
	Dugway, Utah, Wet Clay	Camp Cooke, California, Wet Clay	WES Clay Pad	WES Natural Clay	Panama Residual	Dugway, Utah, Dry Clay
Source	26	26	42	44	50	26
Depth range of samples, ft	1-4	2-12	0-8	1-6	0-12	0-20
Mechanical analysis, % finer than						
0.1 mm			98	99		
0.05 mm			94	95		
0.01 mm			25	32		
0.005 mm			13	22		
Classification	Medium to lean clay	Sandy or silty clay (CL)	Lean clay	Lean clay	Lean clay	Clay (CH or CL)
Avg liquid limit	40	29	43	37	58.2	45
Avg plasticity index	19	10	20	13	8.3	20
Avg specific gravity	2.75	2.66				2.66
Avg field dry weight, lb/cu ft	89.0	100	97	88	73	76.9
Avg field wet weight, lb/cu ft	116.6	124	117	106	110	90.1
Avg field moisture, %	31.5	24.3	20.8	20.1	43.4	17.7
Approximate water table depth, ft		5.5				300
Avg angle of internal friction, deg	22			15		
Avg seismic velocity, fps	5000			1120		3000

Table 8

Properties of Sands

	Area				
	Dugway, Utah, Wet Sand	Camp Cooke, California, Wet Sand	WES Interface Wet Sand	Yucca Flats Sand-Gravel	WES Interface Dry-to-Moist Sand
Source	26	26	41	26	41
Depth range of samples, ft	0-100	2-20	0-0.625	0-185	0-12.5
Mechanical analysis, % finer than					
No. 10		100		87	
No. 40		83		55	
No. 60	48	46		40	
No. 200	25	5		5	
Classification	Silty dune sand	Silty sand (SP-SM)	River sand	Sand-gravel mix	River sand
Avg plasticity index	NP	NP	NP	NP	NP
Avg specific gravity	2.67	2.64		2.56	
Avg field dry weight, lb/cu ft	97.9	82.2	97		96.5
Avg field wet weight, lb/cu ft	100.7	120	108.2	84.5	103
Avg field moisture, %	3	Above WT-22	11.8		6.6
Approximate water table depth, ft	150	2		1000	
Avg angle of internal friction, deg	32			49	
Avg field plate bearing, lb/sq ft				5000 at 2 ft	
Avg seismic velocity, fps	1500			3000	1250

Table 9

Properties of WES Loess and Silt, and Keweenaw Frozen Silt

	Area		
	WES Test Site Loess	WES Silt Natural	Keweenaw Silt Blast Hole 184
Source	39	44	22
Depth range of samples, ft	0-3	0-6	0-5
Mechanical analysis, % finer than			
0.1 mm	100	99	88
0.05 mm	96	93	24
0.01 mm	38	32	7
0.005 mm	22	21	
Classification	Loess	Sandy silt	Sandy silt
Avg liquid limit	41.8	34.75	
Avg plasticity index	20.5	9.5	NP
Avg specific gravity		——	2.63
Avg field dry weight, lb per cu ft	95	88.38	78.9
Avg field wet weight, lb per cu ft	113	114	106
Avg field moisture content, %	19.0	28.86	34.1
Avg angle of internal friction, deg		9.5	

Table 10

Properties of Chalk, Granite, Marlstone, and Sandstone

	Area				
	Niobrara Chalk	Lithonia Granite	Unaweep Granite	Green River Marlstone	Kanawha Sandstone
Source	8	8	13	8	8
Description	Chalky limestone	Gneissic	Fine to very coarse grained	Kerogenaceous, dolomitic limestone (oil shale)	Coarse grained
Apparent specific gravity	2.0	2.6	2.68	2.1	2.2
Tensile strength, psi		450	600		70
Compressive strength, psi	2,000	30,000	24,800	10,000	10,000
Tensile bearing strain, in./in.		280			500
Modulus of rupture, psi	300	2,000	2,510	400	400
Scleroscope hardness	10	85		45	30
Elastic constants (dynamic methods)					
Young's modulus, psi	0.75×10^6	3.0×10^6	4.37×10^6	1.2×10^6	1.0×10^6
Modulus of rigidity, psi	0.5×10^6	1.5×10^6	2.44×10^6	0.5×10^6	0.5×10^6
Longitudinal bar velocity, fps	5,000	9,000	10,800	6,000	5,000
Longitudinal field velocity, fps	7,500	18,500		13,000	5,000
Torsional velocity, fps			8,190		

APPENDIX A: ADDITIONAL CRATERING DATA

1. Since the completion of the draft of this report, additional cratering data have been received. These data are included herein and constitute, along with the main body of this report, all cratering data available at this time. The data presented in table A1 were extracted from two reports listed as references A1* and A2 in the "Source" column of table A1.

Properties of the Various Media Cratered

Suffield Experimental Station (SES), Ralston, Alberta (reference A2)

2. Shots were fired at the SES in two areas, the Watching Hill Range and the Drowning Ford Flats Range. The surface conditions at these two sites are virtually identical. Approximately 80 per cent of all tested material was in the silt range, that is, finer than the No. 200 sieve.

> "Samples from the topmost layers had moisture contents ranging from 2 to 3 percent to around 20 percent, and densities in the range 73-110 lb/cu. ft. The unconfined compressive strength was on the average about 10 tons/sq. ft. and the shear strength ranged from 0 up to a maximum of 14 tons/sq. ft. The percentage recovery after a compressive load of 1000 psi ranged from 5 percent to 18 percent."A2

3. When the position of the charge center of gravity was not given, it was computed from knowledge of the charge shape and weight, and by assuming a packing density of 90 lb per cu ft. Some of the charges used were various types of bombs. In computing the actual weight of explosive contained in a bomb, one-half of the total weight was assumed to be explosive.

Railroad Vulnerability Program (reference A1)

4. The shots fired in the Railroad Vulnerability Program were detonated at Fort Eustis, Virginia. The soil consisted mainly of sandy silt except for the 378-lb charges which were fired in a soil consisting primarily of clay.

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* Refer to corresponding numbers in list of references at end of appendix.

"Soil samples were taken throughout the test area to determine soil properties relevant to the test objectives. The soil parameters measured included grain-size distribution, Atterberg limits (liquid and plastic), cohesive strength and angle of internal friction, density, and moisture content.

"Most of the soil encountered was classified as sand or sandy silt. In general, the soils with the higher percentages of clay were found near the surface. Both the strength tests and the Atterberg indices indicated cohesive strengths ranging from 0 psi in the sands to 20 psi in the soils with higher clay contents."A1

References

A1. Case Institute of Technology, Railroad Vulnerability Program (SECRET). Technical Memorandum No. 21, University Circle, Cleveland, Ohio, August 1958.

A2. Jones, G. H. S., Spackman, N., and Winfield, F. H., Cratering by Ground Burst TNT at Suffield Experimental Station, Ralston, Alberta (UNCLASSIFIED). Suffield Technical Paper No. 158, August 1959.

Table A1

Results of Crater Measurements in Soil

ITEM NO.	SOURCE*	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W, LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS, APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
						Shots Fired in Silt											
1710	A2	1	TNT	8	8	2	+0.28	+0.14	0.7	0.8							
1711	A2	2	TNT	8	8	2	+0.28	+0.14	0.7	0.8							
1712	A2	3	TNT	8	8	2	+0.28	+0.14	0.7	0.8							
1713	A2	4	TNT	8	8	2	+0.28	+0.14	0.8	0.8							
1714	A2	5	TNT	8	8	2	+0.28	+0.14	0.7	0.8							
1715	A2	6	TNT	8	8	2	+0.28	+0.14	0.7	0.8							
1716	A2	7	TNT	8	8	2	+0.28	+0.14	0.6	0.8							
1717	A2	8	TNT	8	8	2	+0.28	+0.14	0.3	0.8							
1718	A2	9	TNT	8	8	2	+0.28	+0.14	0.5	0.8							
1719	A2	10	TNT	8	8	2	+0.28	+0.14	0.5	0.7							
1720	A2	41	TNT	60	60	3.9	+0.54	+0.14	1.4	2.4							
1721	A2	42	TNT	60	60	3.9	+0.54	+0.14	1.5	2.3							
1722	A2	43	TNT	60	60	3.9	+0.54	+0.14	1.4	2.4							
1723	A2	44	TNT	60	60	3.9	+0.54	+0.14	1.6	2.2							
1724	A2	45	TNT	60	60	3.9	+0.54	+0.14	1.6	2.4							
1725	A2	46	TNT	60	60	3.9	+0.54	+0.14	1.3	2.0							
1726	A2	47	TNT	60	60	3.9	+0.54	+0.14	1.5	1.9							
1727	A2	48	TNT	60	60	3.9	+0.54	+0.14	1.8	1.8							
1728	A2	49	TNT	60	60	3.9	+0.54	-0.14	1.7	1.9							
1729	A2	50	TNT	60	60	3.9	+0.54	-0.14	1.5	1.9							
1730	A2	70	TNT	60	60	3.9	+0.54	+0.14	1.7	2.0							
1731	A2	71	TNT	60	60	3.9	-0.54	+0.14	1.9	1.9							
1732	A2	72	TNT	60	60	3.9	+0.54	+0.14	No data obtained								
1733	A2	73	TNT	60	60	3.9	+0.54	-0.14	1.6	2.0							
1734	A2	63**	TNT	1,040	1,040	10.1	+1.77	+0.14	1.9	3.5							
1735	A2		TNT	1,045	1,045	10.1	+1.77	+0.14	1.7	6.0				3.4			
1736	A2	31	TNT	30	30	3.1	+0.23	+0.07	1.8	1.7							

* Numbers correspond to Appendix A reference numbers.

** Shot detonated on surface of deeply frozen ground.

Table A1 (Continued)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA				CHARGE POSITION		CRATER DIMENSIONS								
									APPARENT					TRUE			
			EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB–TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	Z FT	λ_c	d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Silt (Continued)														
1737	A2	32	TNT	30	30	3.1	+0.23	+0.07	2.2	1.6							
1738	A2	33	TNT	30	30	3.1	+0.23	+0.07	2.0	2.0							
1739	A2	34	TNT	30	30	3.1	+0.23	+0.07	2.7	1.6							
1740	A2	35	TNT	30	30	3.1	+0.23	+0.07	2.1	1.6							
1741	A2	36	TNT	33	30	3.1	+0.23	+0.07	2.1	1.5							
1742	A2	37	TNT	30	30	3.1	+0.23	+0.07	2.3	1.6							
1743	A2	38	TNT	30	30	3.1	+0.23	+0.07	3.0	1.5							
1744	A2	39	TNT	30	30	3.10	+0.23	+0.07	2.1	1.6							
1745	A2	40	TNT	30	30	3.10	+0.23	+0.07	2.6	1.6							
1746	A2	68	TNT	520	520	8.05	+0.59	+0.07	3.43	6.2	0.2						
1747	A2	62	TNT	512	512	8.0	+0.59	+0.07	4.8	6.2	1.1			5.8			
1748	A2	67	TNT	521	521	8.05	+0.59	+0.07	3.26	5.8	0.4						
1749	A2	66	TNT	523	523	8.05	+0.59	+0.07	3.0	5.8	0.3						
1750	A2	64	TNT	552	551	8.20	+0.60	+0.07	3.8	6.1	0.5						
1751	A2	65	TNT	600	600	8.43	+0.62	+0.07	3.7	6.6	0.5						
1752	A2	21	TNT	8	8	2	+0.12	+0.06	1.5	1.0							
1753	A2	22	TNT	8	8	2	+0.12	+0.06	1.6	1.0							
1754	A2	23	TNT	8	8	2	+0.12	+0.06	1.7	0.9							
1755	A2	24	TNT	8	8	2	+0.12	+0.06	1.5	0.9							
1756	A2	25	TNT	8	8	2	+0.12	+0.06	1.6	0.9							
1757	A2	26	TNT	8	8	2	+0.12	+0.06	1.2	0.7							
1758	A2	27	TNT	8	8	2	+0.12	+0.06	1.3	0.6							
1759	A2	28	TNT	8	8	2	+0.12	+0.06	1.4	0.7							
1760	A2	29	TNT	8	8	2	+0.12	+0.06	1.6	0.8							
1761	A2	30	TNT	8	8	2	+0.12	+0.06	1.5	0.8							
1762	A2	11	TNT	8	8	2	0	0	0.9	1.1							
1763	A2	12	TNT	8	8	2	0	0	0.6	1.2							

Table A1 (Continued)

(3 of 4 sheets)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
					Shots Fired in Silt (Continued)												
1764	A2	13	TNT	8	8	2	0	0	0.8	1.1							
1765	A2	14	TNT	8	8	2	0	0	0.7	1.2							
1766	A2	15	TNT	8	8	2	0	0	0.9	1.2							
1767	A2	16	TNT	8	8	2	0	0	1.1	1.2							
1768	A2	17	TNT	8	8	2	0	0	0.9	1.2							
1769	A2	18	TNT	8	8	2	0	0	1.0	1.0							
1770	A2	19	TNT	8	8	2	0	0	1.3	1.4							
1771	A2	20	TNT	8	8	2	0	0	1.0	1.0							
1772	A2	51	TNT	60	60	3.9	0	0	2.0	2.2	0.25						
1773	A2	52	TNT	60	60	3.9	0	0	2.3	2.3	0.25						
1774	A2	53	TNT	60	60	3.9	0	0	2.1	2.4	0.20						
1775	A2	54	TNT	60	60	3.9	0	0	2.4	2.3	0.20						
1776	A2	55	TNT	60	60	3.9	0	0	2.4	2.4							
1777	A2	56	TNT	60	60	3.9	0	0	2.4	2.8	0.30						
1778	A2	57	TNT	60	60	3.9	0	0	2.2	2.9	0.38						
1779	A2	58	TNT	60	60	3.9	0	0	2.4	3.1	0.30						
1780	A2	59	TNT	60	60	3.9	0	0	1.8	2.4	0.30						
1781	A2	60	TNT	60	60	3.9	0	0	2.0	2.4							
					Shots Fired in Sandy Silt												
1782	A1	40†	TNT	270	270	6.46	-5.5	-0.85	6.0	17.4							
1783	A1	52	TNT	540	540	8.15	-7.0	-0.86	9.2	20.4							
1784	A1	61†	TNT	540	540	8.15	-8.0	-0.98	9.1	21.4							
1785	A1	57†	TNT	540	540	8.15	-8.3	-1.02	9.3	19.4							
1786	A1	[illegible]	TNT	270	270	6.46	-7.8	-1.20	6.9	16.9							
1787	A1	53	TNT	54	54	3.78	-4.7	-1.24	6.0	11.0							
1788	A1	54	TNT	54	54	3.78	-4.7	-1.24	6.3	11.3							
1789	A1	55	TNT	54	54	3.78	-4.7	-1.24	5.7	11.0							

ension affected by boundary condition not included in calculation of crater radius.

Table A1 (Concluded)

ITEM NO.	SOURCE	SHOT NUMBER	EXPLOSIVE DATA: EXPLOSIVE TYPE	CHARGE WEIGHT LB	W LB-TNT EQUIVALENT	$W^{1/3}$ $LB^{1/3}$	CHARGE POSITION: Z FT	λ_c	CRATER DIMENSIONS: APPARENT: d_a FT	r_a FT	h_a FT	α_a DEG	V_a CU FT	TRUE: d_t FT	r_t FT	α_t DEG	V_t CU FT
			Shots Fired in Sandy Silt (Continued)														
1790	A1	56	TNT	54	54	3.78	-4.7	-1.24	4.4	8.0							
1791	A1	44†	TNT	270	270	6.46	-8.0	-1.24	6.2	12.7							
1792	A1	49	TNT	270	270	6.46	-8.0	-1.24	7.0	15.8							
1793	A1	39†	TNT	81	81	4.33	-5.4	-1.25	6.5	14.7							
1794	A1	47	TNT	81	81	4.33	-5.4	-1.25	6.2	12.2							
1795	A1	63†	TNT	81	81	4.33	-5.4	-1.25	7.0	11.8							
1796	A1	46†	TNT	270	270	6.46	-8.9	-1.38	7.8	15.9							
			Shots Fired in Clay														
1797	A1	59	TNT	378	378	7.23	-4.5	-0.62	9.3	20.0							
1798	A1	58†	TNT	378	378	7.23	-8.4	-1.16	8.8	21.2							
1799	A1	62†	TNT	378	378	7.23	-8.5	-1.18	11.1	20.5							
1800	A1	60†	TNT	378	378	7.23	-8.7	-1.20	7.8	18.9							
1801	A1	50†	TNT	378	378	7.23	-9.0	-1.24	9.0	18.2							

† Dimension affected by boundary condition not included in calculation of crater radius.